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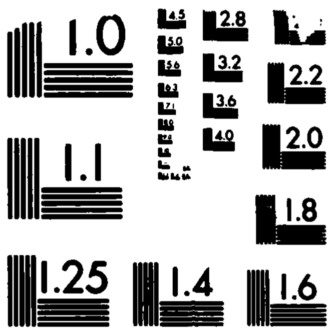

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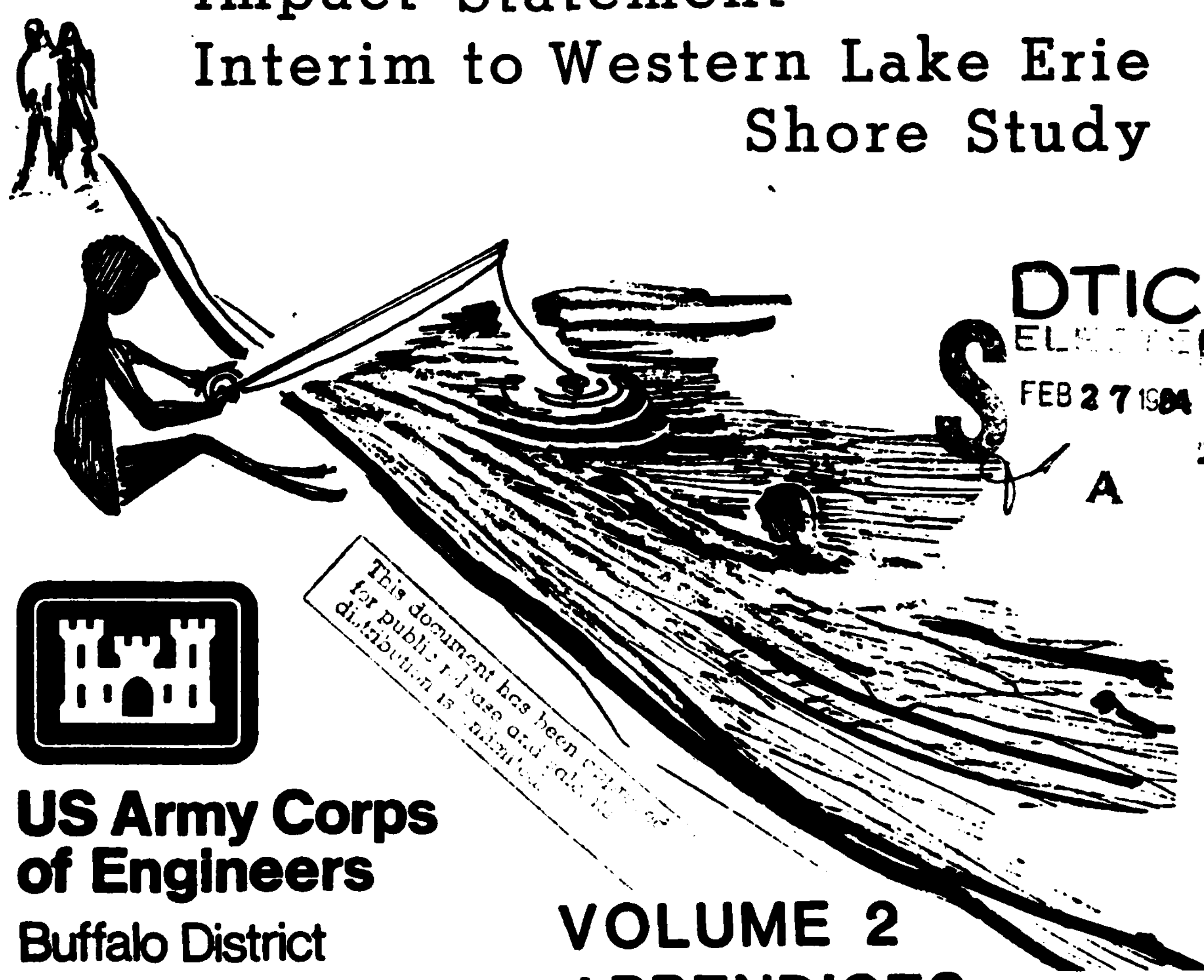
MAUMEE BAY STATE PARK, OHIO

AD-A138 420

SHORELINE EROSION BEACH RESTORATION STUDY

Final Feasibility Report and Final Environmental Impact Statement Interim to Western Lake Erie Shore Study



US Army Corps of Engineers
Buffalo District

December 1983

VOLUME 2 APPENDICES

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
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Shoreline Erosion
Beach Restoration
Maumee Bay State Park
Western Lake Erie Shore Study

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Ohio Department of Natural Resources (ODNR) is developing a mutiuse facility on the shore of Lake Erie near Toledo, OH, called Maumee Bay State Park. They have requested Corps assistance in designing and cost-sharing structures to halt the severe shoreline erosion which is occurring, so that the park can be developed to its full potential.

A plan for accomplishing the stated purpose has been developed. It would provide a protective sand beach, 250 Feet wide by 5,500 feet long over

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

the western half of the park, stabilized by eight 300-foot offshore rubblemound breakwaters. the eastern half of the park would be protected by a rubblemound revetment placed along the existing shoreline, while the drainage ditches would be protected by rubblemound jetties.

The plan recommended for construction is environmentally acceptabl engineeringly and economically feasible, and has an estimated first cost of $11.8 million. In addition, ODNR plans an expenditure of $3.3 million for their associated development which will include a bathhouse, parking, and lands. Average annual benefits for the Federal project and associated ODNR development are $5.7 million. With total annual cjarges of $1.7 million, the benefit-to-codt ratio is 3.41 tol.0.

ODNR is fully supportive of the Coprs shoreline protection plan. There is no known opposition to this plan or to the planned park development of the State.

APPENDIX A
GEOTECHNICAL DESIGN

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

A-1

MAUMEE BAY STATE PARK, OHIO

INDEX OF APPENDICES

APPENDIX	TITLE
A	GEOTECHNICAL DESIGNS
B	ECONOMIC EVALUATION
C	COST ESTIMATES
D	DESIGN AND COASTAL PROCESSES
E	CORRESPONDENCE
F	PUBLIC INVOLVEMENT
G	FISH AND WILDLIFE REPORT
H	CULTURAL RESOURCES
I	ENVIRONMENTAL AND WETLAND REPORT
J	PUBLIC VIEWS AND RESPONSES

MAUMEE BAY STATE PARK, OHIO
DRAFT FINAL FEASIBILITY REPORT (STAGE 3)

APPENDIX A
GEOTECHNICAL DESIGN

TABLE OF CONTENTS

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APPENDIX A

GEOTECHNICAL DESIGN

A1. REGIONAL GEOTECHNICAL INFORMATION

A1.1 Physiography

Maumee Bay State Park is located on the southern shoreline of Lake Erie and lies within the Lake Plains section of the Central Lowlands Province. The Lake Plains section is characterized by nearly flat to gently undulating topography veneered with glacial lake deposits. The region has been glaciated several times in the past, most recently within the Wisconsin glacial stage about 10,000 to 50,000 years before present (BP). End and ground moraines deposited by the glacier form the hummocky terrain characteristic of the Till Plains Section of the Central Lowlands Province which lies south of the project area. As the ice receded, glacial lakes were formed in which fine silts and clays were deposited. These glaciolacustrine deposits are exposed along the Maumee Bay shoreline where 1 to 5-foot high banks have been formed by wave action.

A1.2 Bedrock Geology

Northwestern Ohio is underlain by thick sedimentary rock sequences of Paleozoic age. These rock sequences, consisting of limestones, dolomites; and shales were originally deposited within inland seas which covered the region. Carbonate rocks were deposited along the axis of a regional anticlinal feature known as the Findlay Arch. The arch, actually an extension of the north-south trending Cincinnati Arch, formed a level shelf above adjoining basins to the east and west into which deep water shales were deposited. The shallow marine shelf environment was conductive to the precipitation of calcium carbonate by marine dwelling organisms. Consequently, alternating sequences of similar lithology were deposited by transgressive and regressive sea waters. During periods of regression, confined shallow basins were exposed, which upon evaporating caused the precipitation of dissolved minerals and formed deposits of carbonate rock sequences rich in gypsum and anhydrite. Carbonate rocks of the region contain abundant fossil assemblages including reef building organisms such as corals and stromatoporoids.

A1.3 Surficial Geology

The unconsolidated sediments overlying bedrock in northwestern Ohio are the result of glacial and lacustrine deposition. Herdendorf and Braidech (1972) state that during the Pleistocene epoch, western Lake Erie was covered by at least two continental ice sheets and later by a series of glacial lakes, resulting in the deposition of lacustrine sediments. Hough (1966) describes the Wisconsin drift sheet as the youngest and most completely preserved of the Pleistocene glacial deposits. Wisconsin glaciation resulted in the formation of end moraines which accumulated at the retreating edge of the ice sheet during stagnant periods. A series of end moraines occurs within the Till Plains Section and lie roughly parallel to the present shoreline of

Lake Erie. During periods of rapid ice retreat, a veneer of ground moraine consisting of glacial till was deposited over the land surface. In addition to end and ground moraine deposits, scattered kames and eskers were formed by the ice sheet.

As the last of the Wisconsin glaciers retreated about 15,000 BP, an abundant supply of melt water was generated. Outwash sand and gravel carried by melt water streams filled in valley bottoms and in many instances are found directly overlying till deposits. As a result of the impoundment of melt water at the front of the receding glacier, glacial Lake Maumee was formed and at its maximum height was approximately 218 feet above present Lake Erie. The formation of glacial Lake Maumee resulted in the widespread deposition of silt and clay. Ancient shorelines corresponding to elevated lake levels are represented by beach deposits found overlying older till and lacustrine deposits.

A2. LOCAL GEOTECHNICAL INFORMATION

A2.1 Bedrock Geology

Bedrock underlying the project site consists of limestone and dolomite of the Niagaran and Monroe Formations. The Niagaran Formation, Upper Silurian in age, represents the oldest exposed rock unit in northwestern Ohio. The Formation contains predominantly dolomites and limestones with interbedded shales. The deposition of the Monroe Formation began during late Silurian and continued into Devonian time. Typically, thick bedded dolomite and limestone are the predominant rock types of the Monroe Formation, but thin anhydrite beds and shale are also present.

Bedrock underlying Maumee Bay State Park is covered by a relatively thick sequence of unconsolidated surficial deposits. In light of this fact, bedrock will not be a factor in the development of the proposed project.

A2.2 Surficial Geology

Surficial deposits in the vicinity of Maumee Bay State Park consist of three principal types: glacial till, glaciolacustrine silt and clay, and recent lake deposits. Bedrock is directly overlain by a clay rich glacial till which is reported to have an average thickness of 50 feet in western Ohio. Overlying the till are glaciolacustrine deposits which typically consist of grey to grey-brown, stiff, silty clays. Thickness of the glaciolacustrine clays varies from 1 foot to over 30 feet in the vicinity of the project site. Low (1 to 5 feet) high banks formed in glaciolacustrine clay occur along the shoreline at Maumee Bay. The erodibility of the glaciolacustrine clay is well documented and contributes significantly to the high rate of shoreline erosion which is occurring at the project site.

Recent lake deposits consist of both organic muds and sand and gravel deposits. The general distribution of these materials is shown on Figure 4. The offshore sand deposits are important not only from the standpoint of coastal processes as described in Appendix D, but also as a source of beachfill for construction of the proposed project. The only significant sand

deposit in Maumee Bay is an elongated body which extends north-northeast from Cedar Point toward Turtle Island. Bedford et al. (1978) describes this deposit as consisting of fine sand, coarse sand, and gravel, but has a low content of medium sand. It has also been suggested that this particular deposit may be growing as a result of accretion of littorally transported sand material.

A2.3 Subsurface Explorations

Three hand auger borings were advanced in May 1981 to determine general preliminary subsurface conditions at the project site. Refer to Figure 1 for boring locations.

These hand auger borings were performed by Buffalo District geotechnical personnel using a 1-1/2 inch diameter screw-type auger. The borings were advanced to a maximum of 14 feet. The samples consisted of cuttings taken off the auger screw and were visually identified in the field. No laboratory testing was performed; therefore, all classifications are field visual classifications.

Information from the subsurface exploration program is displayed by a geologic profile along the Wildlife Revetment (Plate 3) and three cross sections (Figures 2, 3, and 4).

Only land borings were performed for this project at this study level. Water borings may be required at a later report stage to further disclose site subsurface conditions which may affect the project design.

The hand auger borings disclosed silt clays throughout the limits of sampling, except for a thin veneer of variable, unimportant surficial deposits (sand or peat). No extensive strata of extremely soft compressible soils were disclosed. The primary variations of the clay soils encountered include consistency (soft to stiff) and color (yellow-gray to red-brown). Considering the moderate changes in soil stratification with depth, it appears that the foundation soils are reasonably similar in their general nature.

A3. GEOTECHNICAL DESIGN

A3.1 Project Features

The project consists of 6,200 LF of wildlife revetment, at the shoreline of the eastern half of the project; two 250 LF jetties; a 450 LF west shore revetment; a 5,500 LF protective sand beach; and eight 300 LF offshore breakwaters. Refer to Figure 1.

A3.2 Stress Analysis

The soils underlying the project site are generally silts and clays, stiff to medium-stiff in consistency. Considering the low total height of the revetments and the relatively favorable apparent soil strength conditions, no apparent problem exists relative to overstressing the foundation soils. No conclusions can be made regarding the offshore structures

(offshore breakwaters and jetties) due to a total lack of subsurface data (this is common for the following sections as well).

A3.3 Settlement Analysis

Based on the limited available subsurface information, only minor settlements are anticipated due to the loads imposed by the project design features. More detailed subsurface information which will be obtained at the detail design level is required to refine this analysis.

A3.4 Stability Analysis

The project design features are all relatively low structures with moderate side slopes. Considering the favorable existing subsurface conditions which have been disclosed at the site, no problems of stability are foreseen.

A3.5 Compatibility of Structures with Foundation

All the design features are to be built directly upon the existing ground surface. The design features are flexible in all cases and will be compatible with the existing foundation soils.

The only significant concern regarding seepage and fiter considerations is the use of a filter fabric course under the revetment and jetties. This is designed to prevent the removal of foundation soil fines from the surficial silt-clay stratum by wave action with subsequent foundation distress. There is no concern or provision for passage of water through these structures, since the land directly behind the revetment is low wetland. The jetties have a filter fabric course through the center of their cross section to allow for passage of infiltrating water without coincident passage of littoral drift material.

A3.6 Construction Materials

Stone - Several sources of armor, underlayer, bedding stone, and concrete aggregates have been identified within a 50-mile radius of the project site. They are displayed on Plates 1 and 2, titled "Summary of Possible Sources." Each identified source contains suitable in-place rock to produce acceptable quality production stone of the sizes specified. However, the right will be reserved to reject materials from certain localized areas, zones, strata, channels, or stockpiles, when such materials are deemed unsuitable.

Selective quarrying may be necessary to produce some material types. Blasting techniques used for normal aggregate production will require adjustments or in some cases complete tailoring to produce cover stone. Project specifications will require that shale and other deleterious materials will be excluded by adequate processing. The specification also, will require stockpiling of protection stone prior to use in construction.

It is anticipated that listed inland quarries will utilize truck or rail haul for transport of stone; whereas Standard Slag at Marblehead, OH,

will be able to utilize water transport should docking facilities be available near the job site.

Beachfill - There are two potential sources of large quantities of beachfill for this project. They are: Erie Sand and Gravel, Sandusky and Lorain, OH; and White Brothers Sand Company (Division of Kuhlman Corporation), Toledo, OH. Both of these potential sources were contacted and have expressed interest in supplying sand material for the project.

The required gradation for beachfill will depend on whether a structural or non-structural alternative is selected. Presently, the beachfill design calls for a fine to medium sand product. It is anticipated that those sources which normally produce Ohio Department of Transportation (Ohio DOT) gradations will be capable of producing the required beachfill. Ohio DOT gradation specifications are shown on Table 1.

Erie Sand and Gravel (Lorain Office) dredges sand from two authorized permit areas in Lake Erie. One area is located offshore from Vermilion, OH, and is authorized for approximately 200,000 cubic yards of sand dredging per year. The second area is located offshore from Fairport, OH, and is authorized for unlimited sand dredging according to Erie Sand and Gravel Company. The Fairport dredging area served as the source of beachfill for the Cooperative Beach Erosion Control Project for Lakeview Park, Lorain, OH. Most of the sand from both of the permit areas is produced to meet Ohio DOT gradation for fine aggregate for concrete. A minor amount of Ohio DOT fine aggregate for mortar is also produced. It should be noted that lake-dredged sand produced by Erie Sand and Gravel undergoes minimal screen processing. The gradation of the produced product is essentially dictated by the gradation of the in-situ sand deposit.

White Brothers Sand and Gravel has held dredging permits in Maumee Bay and Maumee River near Toledo, OH. At the present time, the company dredges sand exclusively from deposits within Maumee River. White Brothers produces both Ohio DOT fine aggregate for concrete and fine aggregate for mortar. It appears that sand deposits dredged in Maumee Bay are somewhat finer than those found in the Maumee River. Similar to Erie Sand and Gravel, White Brothers performs very limited screen processing of most of their dredged sand. Company officials have stated that the most feasible source of beachfill for the Maumee Bay State Park Project would be the offshore sand deposit in Maumee Bay. Due to the fine grain size of sand in this deposit, it has been dredged for mortar (or mason) sand only. However, the company has stated that by adjusting onboard screens, they could produce a coarser product approaching the gradation of Ohio DOT fine aggregate for concrete.

Presently, White Brothers can produce approximately 300 tons of sand per day. The company has reported that by upgrading their present dredging equipment and gearing up for a large project, they could possibly produce 2,000-3,000 tons of sand per day. Should large quantities of sand be furnished by White Brothers Sand Company, it is anticipated that they would apply for additional Department of the Army dredging permits in order to avoid depleting their available reserves.

As stated previously, the most economically feasible source of beachfill sand for this project is the offshore sand deposit in Maumee Bay. The Maumee Bay deposit, at its closest point, lies within approximately 1 mile of the proposed project area. According to Hartley (1960), the Maumee Bay sand and gravel deposit is a low ridge widening from less than 1/2-mile at Cedar Point to more than 2 miles at its northern end near Turtle Island. Figure 4 shows the general distribution of the Maumee Bay deposit and the location of two previously authorized permit dredging areas (Areas A and B). The higher surfaces of the sand deposit rise to a maximum of about 7 feet above the underlying lake bottom materials consisting of stiff consolidated clays.

As of December 1974, the quantity of commercial quality sand material in the Maumee Bay deposit was estimated by Herdendorf and Cooper (1975) to be 5,751,228 cubic yards. Ohio Geological Survey records indicate that 14,212 cubic yards of sand have been removed from the Maumee Bay deposit between 1975 and 1980. At the present low rate of depletion, it is anticipated that more than adequate reserves of sand are available in the Maumee Bay deposit and can be considered a viable source of beachfill for the proposed project well into the future.

Considering that the offshore sand deposit in Maumee Bay is the most feasible source of beachfill for the project, two alternatives exist for transporting the dredged sand to the project site. The conventional method is for White Brothers Company to dredge the sand and haul it to their unloading docks at Toledo, OH. The sand would then be trucked approximately 5 miles to the project site. The second alternative is to dredge the sand from the Maumee Bay deposit and pump it via pipeline directly to the beach area. This operation could be accomplished by either White Brothers Company, Corps of Engineers, or Contractor-operated dredge boats.

4. CONSTRUCTION CONSIDERATIONS

A4.1 Construction Procedures

No special procedures are anticipated for construction of this project. Suitable access may be a problem, since much of the eastern half of the project is swampy, wooded terrain.

Table A1 - State of Ohio Department of Transportation
Aggregate Specificaions

Section 703.02: Aggregate for Portland Cement Concrete

1. General. The fine aggregate shall be natural or manufactured sand composed of clean, hard, durable, uncoated particles of stone, well-graded from coarse to fine, with the coarse particles predominating, free from lumps of clay and all organic matter.

2. Grading (U. S. Standard Sieve Series). The sand shall be well-graded from coarse to fine and when tested by means of laboratory sieves shall conform to the following grading:

Sieve No.	Total Percent Passing Natural	Total Percent Passing Manufactured
3/8-inch	100	
No. 4	95-100	100
No. 8	70-95	90-100
No. 16	45-80	50-75
No. 30	25-60	30-60
No. 50	10-30	14-30
No. 100	1-10	4-12
No. 200	0-4	0-5

Section 703.03: Fine Aggregate for Mortar and Grout

1. General. The fine aggregate shall be either a natural or manufactured sand and shall be composed of clean, hard, durable, uncoated particles of stone, and free from lumps of clay and all organic matter.

2. Grading (U. S. Standard Sieve Series). The sand will be well-graded from coarse to fine and when tested by means of laboratory sieves shall conform to the following grading:

Sieve No.	Total Percent Passing Natural or Manufactured
No. 4	100
No. 8	95-100
No. 50	15-40
No. 100	0-10
No. 200	0-5

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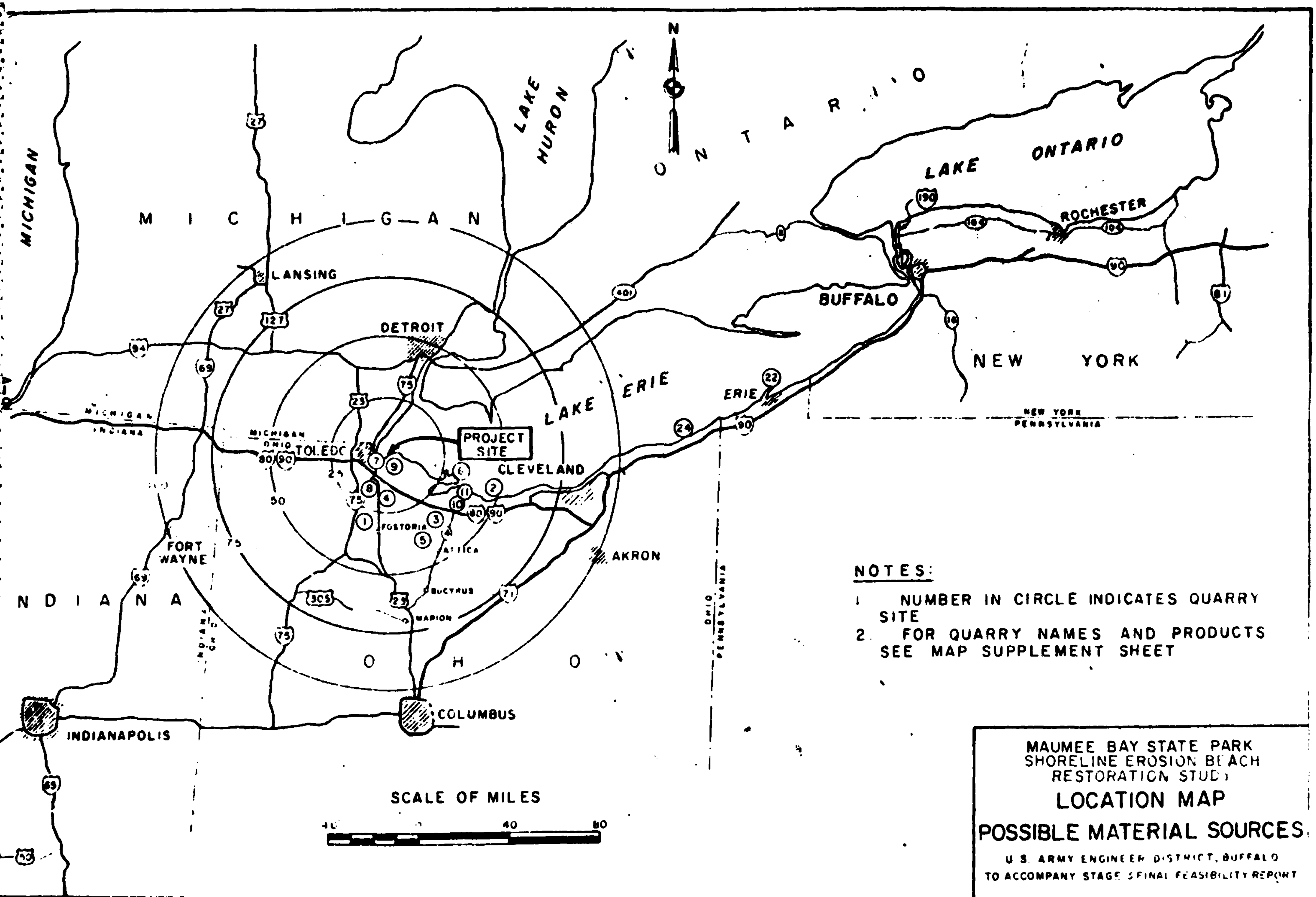


NOTES:

1 NUMBER IN CIRCLE INDICATES QUARRY SITE

2 FOR QUARRY NAMES AND PRODUCTS SEE MAP SUPPLEMENT SHEET

MAUMEE BAY STATE PARK
SHORELINE EROSION BEACH
RESTORATION STUDY

LOCATION MAP

POSSIBLE MATERIAL SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY STAGE 3 FINAL FEASIBILITY REPORT

MAP SUPPLEMENT SHEET
SUMMARY OF POSSIBLE SOURCES FOR CONSTRUCTION MATERIALS

SITE NUMBER	SOURCE	QUARRY OR PIT LOCATION	RADIAL DISTANCE (IN MILES)	ARMOR STONE, TYPES A1, A2	UNDERLAYER STONE, TYPE B	MATTRESS/BEDDING, TYPE C	BEACH FILL SAND	COARSE AGGREGATE	FINE AGGREGATE				
1.	MACRICHIE MATERIALS, INC.	WEST MILLGROVE, OHIO	35	X	X	X		X					
2.	ERIE SAND AND GRAVEL	SANDUSKY AND LORAIN, OHIO	50				X		X				
3.	FRANCE STONE CO.	FLAT ROCK, OHIO	40	X	X	X		X	X				
4.	GOTTRON BROS.	FREMONT, OHIO	20					X					
5	SANDUSKY CRUSHED STONE	PARKERTOWN, OHIO	40			X		X	X				
6.	STANDARD SLAG CO.	MARBLEHEAD, OHIO	35	X	X	X		X	X				
7	WHITE BROS. SAND CO.	TOLEDO, OHIO	5				X		X				
8	WOODVILLE LIME & CHEMICAL	WOODVILLE, OHIO	20	X	X	X		X	X				
9.	EDWARD KRAEMER AND SONS	CLAY CENTER, OH	10	X	X	X		X	X				
10.	ERIE BLACKTOP CORP.	CASTALIA, OH	40	X	X	X							
11.	WAGNER QUARRIES CO.	SANDUSKY, OH	40	X	X	X							

NOTES:

ARMOR STONE, TYPE A1, 1.5 - 4.0 TONS

ARMOR STONE, TYPE A2, 1.5 - 3.0 TONS

UNDERLAYER STONE, TYPE B, 50-1000 LBS.

MATTRESS/BEDDING STONE, TYPE C, 1/4 INCH - 9 INCH (50 LBS)

COARSE AGGREGATE FOR CONCRETE

FINE AGGREGATE FOR CONCRETE

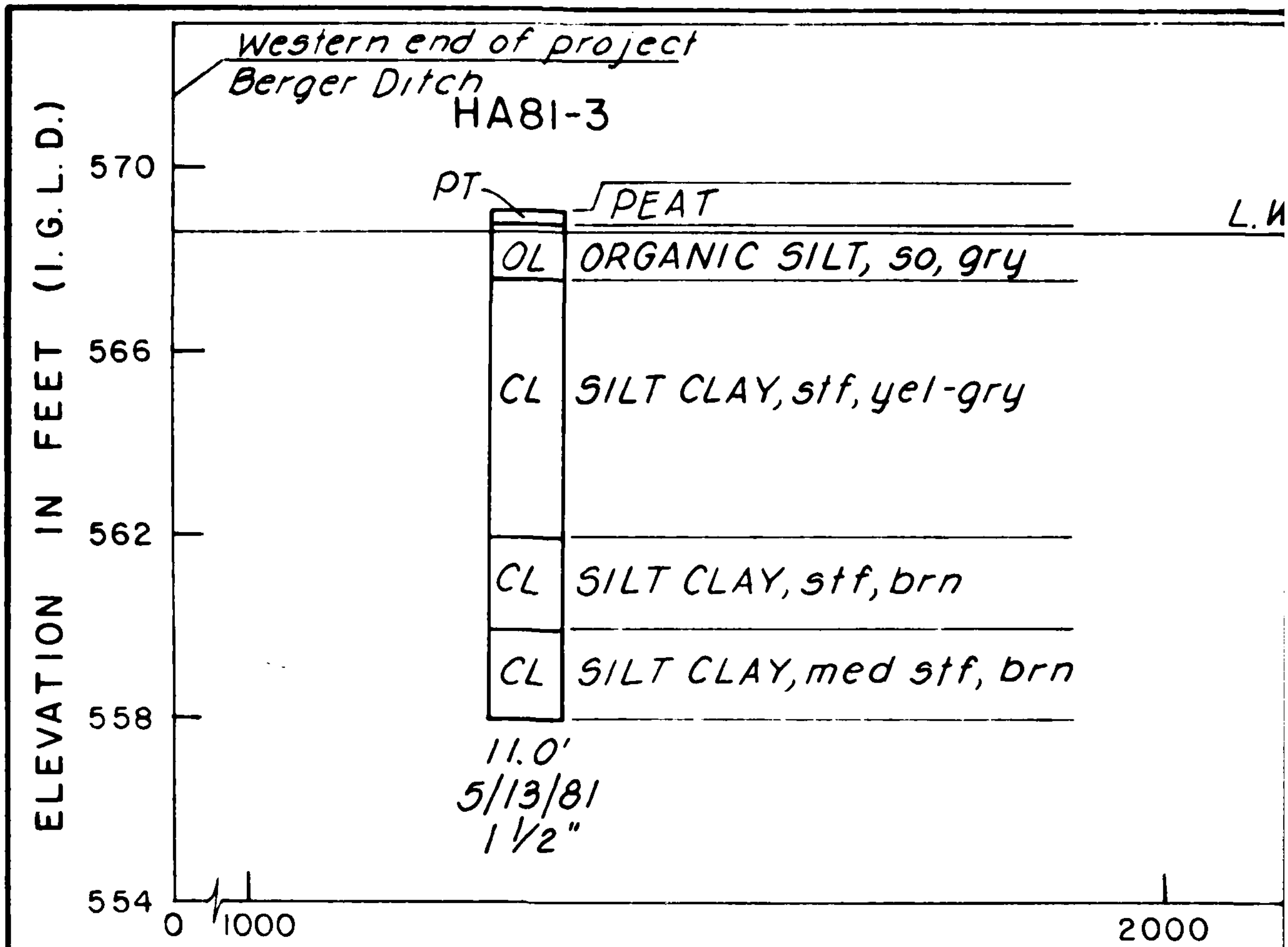
X - INDICATES THAT SOURCE IS CAPABLE OF PRODUCING MATERIAL INDICATED.

MAUMEE BAY STATE PARK
SHORELINE EROSION REACH
RESTORATION STUDY

SUMMARY OF
POSSIBLE SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY STAGE 3 FINAL FEASIBILITY REPORT

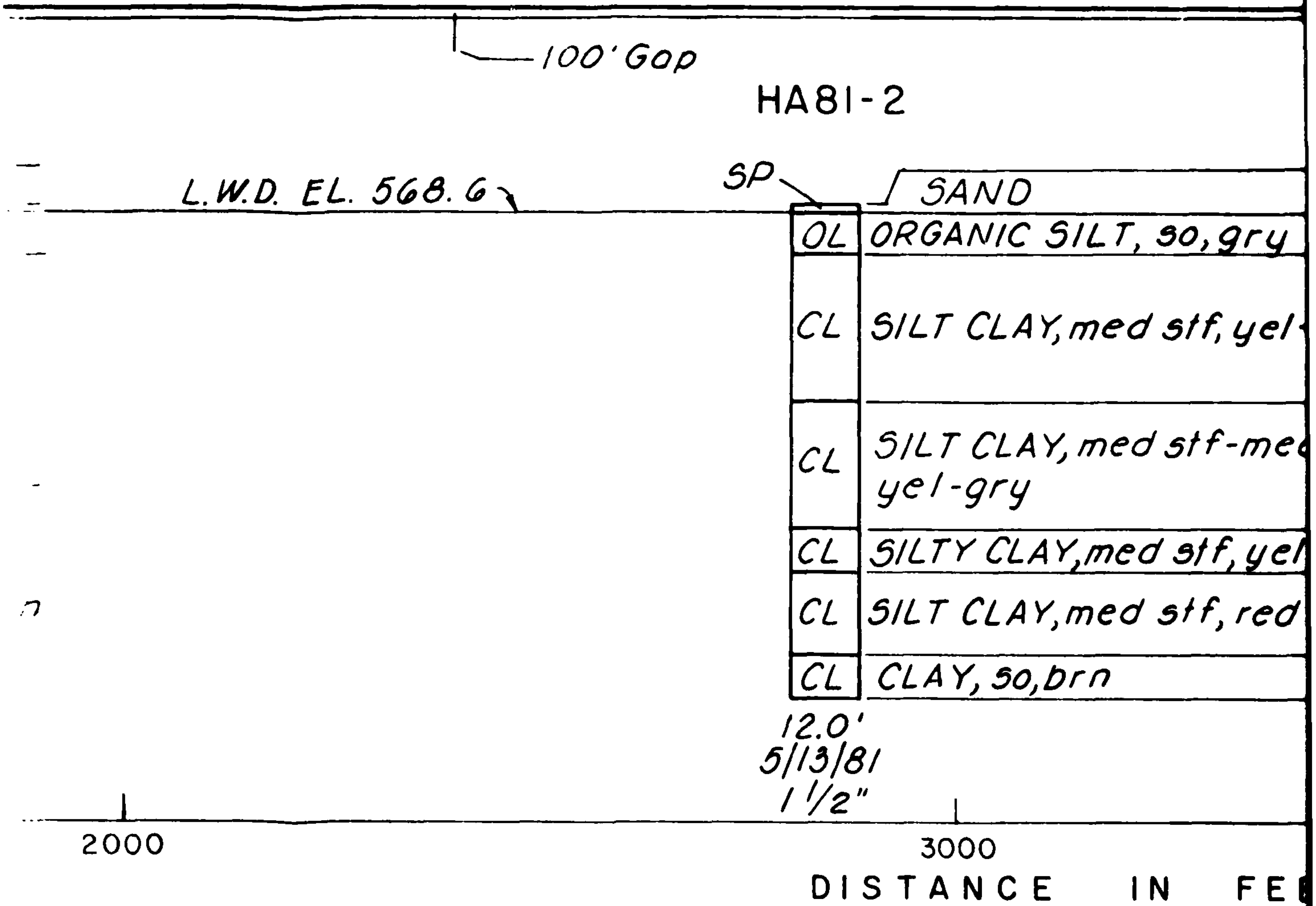
PLATE 2



LEGEND (UNIFIED SOIL CLASSIFICATION SYS

GW	WELL GRADED GRAVELS, GRAVEL SAND MIXTURES, LITTLE OR NO FINES.
GP	POORLY GRADED GRAVELS OR GRAVEL SAND MIXTURES, LITTLE OR NO FINES.
GM	SILTY GRAVELS, GRAVEL SAND SILT MIXTURES.
GC	CLAYEY GRAVELS, GRAVEL SAND CLAY MIXTURES.
SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES.
SM	SILTY SANDS SAND SILT MIXTURES.
SC	CLAYEY SANDS, SAND CLAY MIXTURES.
ML	INORGANIC SILTS AND V FLOUR, SILTY OR CLAYE SILTS WITH SLIGHT PLA
CL	INORGANIC CLAYS OF LO GRAVELLY CLAYS, SANDY LEAN CLAYS.
OL	ORGANIC SILTS AND ORG LOW PLASTICITY.
MH	INORGANIC SILTS, MICA FINE SANDY OR SILTY S
CH	INORGANIC CLAYS OF HI
OH	ORGANIC CLAYS OF MED ORGANIC SILTS.
PT	PEAT AND OTHER HIGHLY

FOR DETAILS ON THE UNIFIED SOIL CLASSIFICATION SYSTEM, SEE WATERWAYS TECHNICAL MEMORANDUM NO. 3-357 DATED MARCH 1953 AND REVISED IN 1960.



GEOLOGIC PROFILE 4-4 (WILDLIF

ATION SYSTEM)

C SILTS AND VERY FINE SANDS, ROCK
ILTY OR CLAYEY FINE SANDS OR CLAYEY
TH SLIGHT PLASTICITY.

C CLAYS OF LOW TO MEDIUM PLASTICITY,
CLAYS, SANDY CLAYS, SILTY CLAYS,
YS.

SILTS AND ORGANIC SILTY CLAYS OF
TICITY.

C SILTS, MICACEOUS OR DIATOMACEOUS
DY OR SILTY SOILS, ELASTIC SILTS.

C CLAYS OF HIGH PLASTICITY, FAT CLAYS.

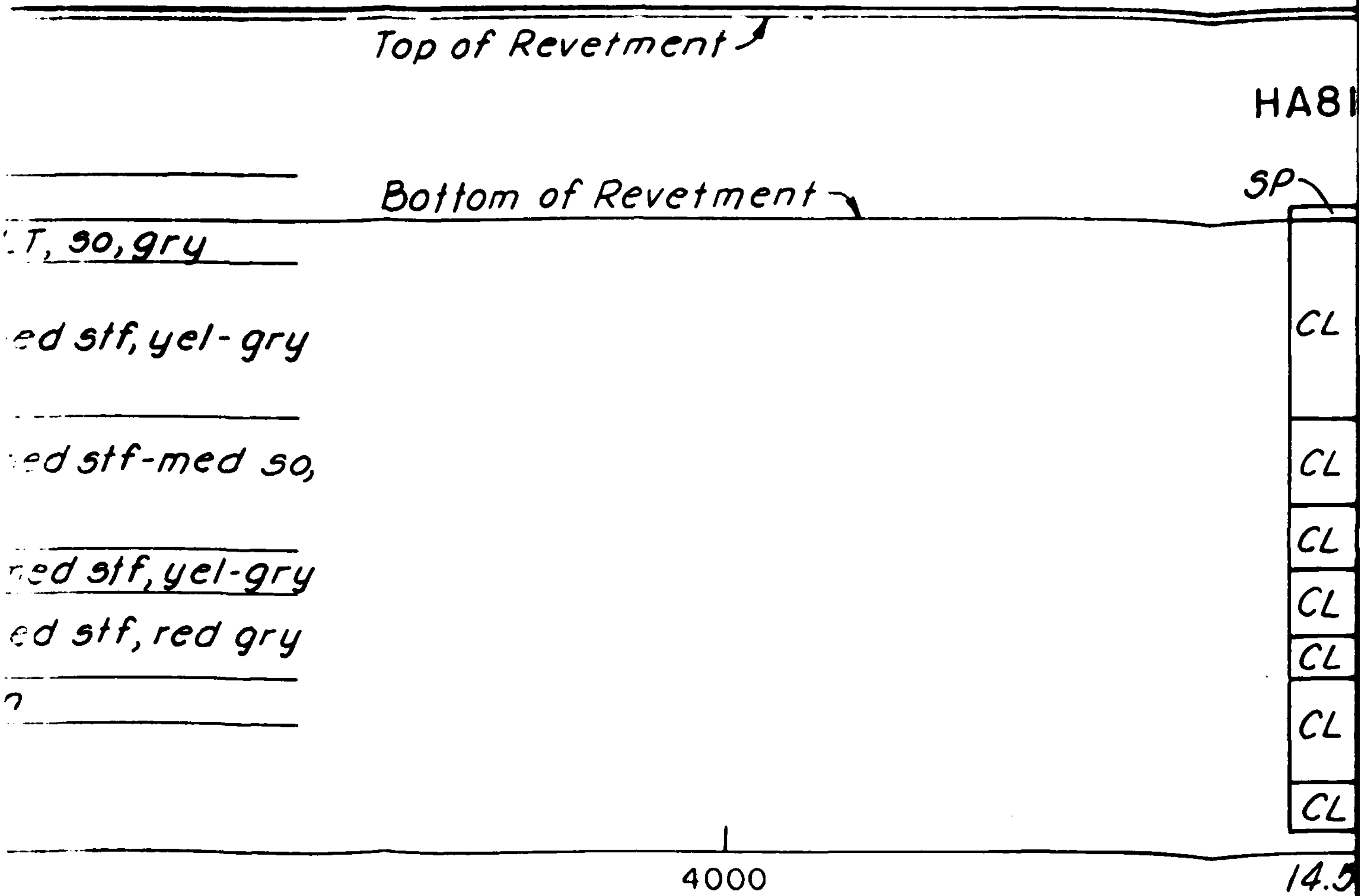
CLAYS OF MEDIUM TO HIGH PLASTICITY,
SILTS.

OTHER HIGHLY ORGANIC SOILS.

EE WATERWAYS EXPERIMENT STATION
ISED IN 1960.

GENERAL NOTES:

1. For Profile Location Plan, see
2. For Geologic Cross Sections
3. All elevations are reference
above Mean Water Level at Fat
Great Lakes Datum 1955).
4. All soil classifications are
cuttings from the hand auge



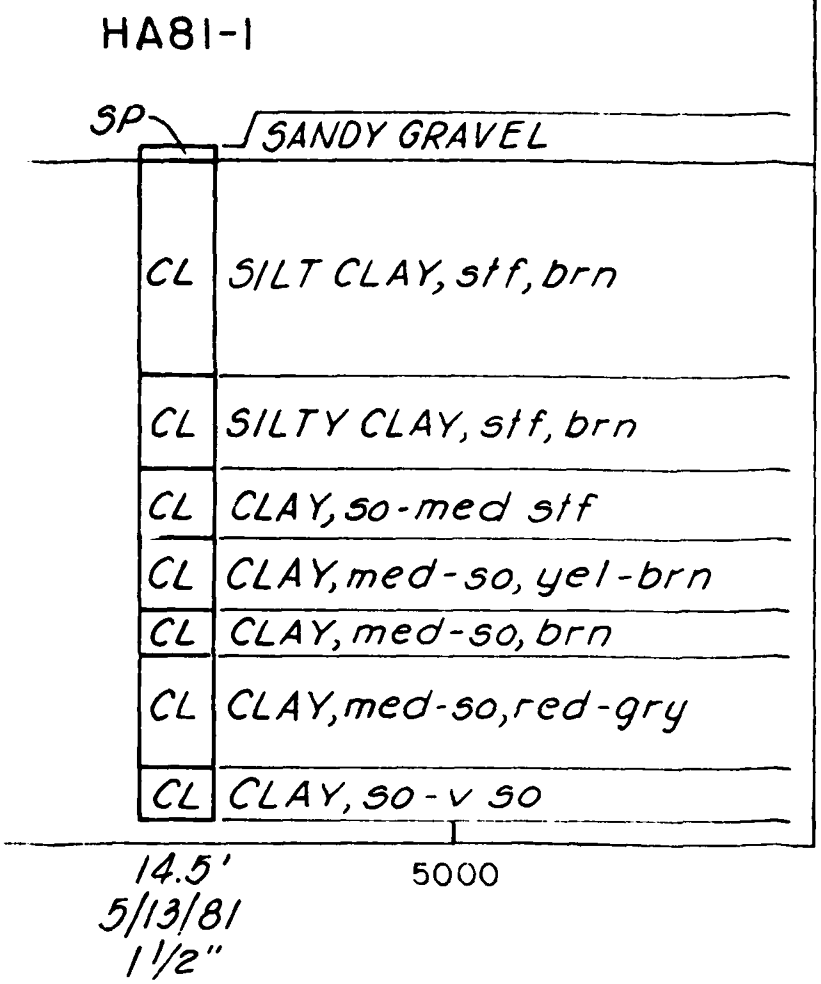
IN FEET

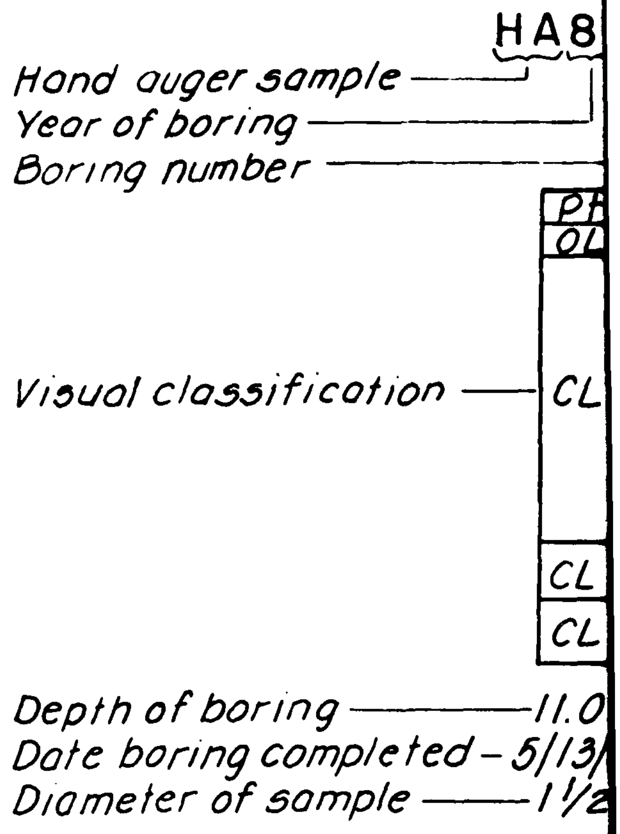
(WILDLIFE REVETMENT)

on Plan, see Figure 1.
s Sections at Boring Locations, see Figures 2, 3 and 4.
referenced to the Low Water Datum El. 568.6 feet
.evel at Father Point, Quebec (IGLD 1955) (International
1955).
ations are field visuals, based on examination of
hand auger at the time the borings were performed.

ABBR

brn -
gry - g
med - m
red - r
so - s
stf - s
v so - v
yel - y





TYPICAL BORING S

ABBREVIATIONS:

brn - brown
gry - gray
med - medium
red - red
so - soft
stf - stiff
v so - very soft
yel - yellow

MAUMEE

GEOLOG
WILDLI

)Y GRAVEL

:LAY, stf, brn

CLAY, stf, brn

so-med stf

med-so, yel-brn

med-so, brn

med-so, red-gry

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HA81-3

Hand auger sample

Year of boring

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Pt

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Visual classification

Material classificatio
from visual
descriptions
as appropriat

CL SILT CLAY, stf,

CL SILT CLAY, med, stf, brn

Depth of boring — 11.0'

Date boring completed – 5/13/81

Diameter of sample — 1 1/2"

TYPICAL BORING SCHEMATIC

IONS:

,

ft

MAUMEE BAY STATE PAR
OHIO

GEOLOGIC PROFILE 4-
WILDLIFE REVETMEN

U.S. ARMY ENGINEER DISTRICT, BUFFAL
DECEMBER 1981

5

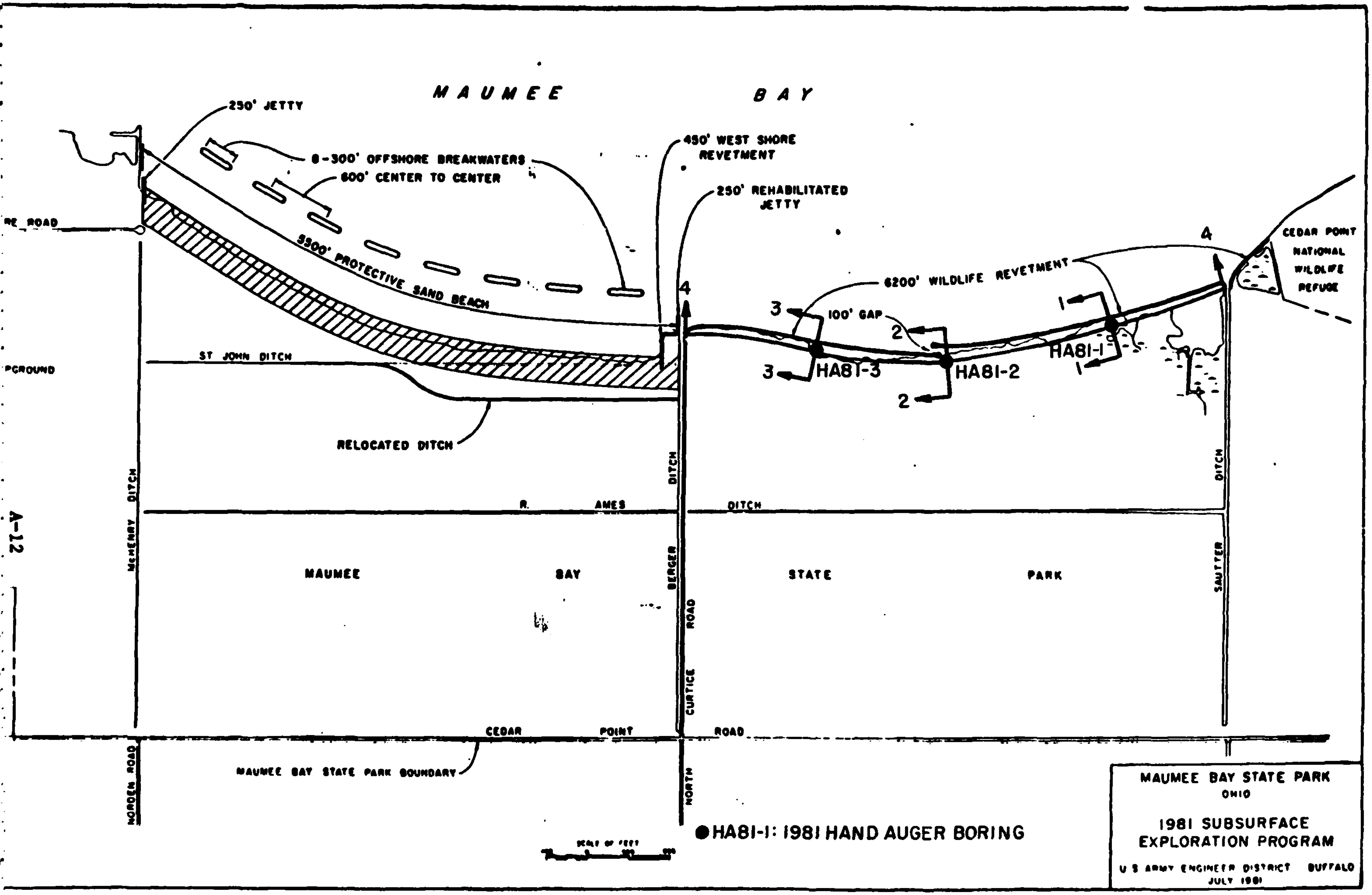
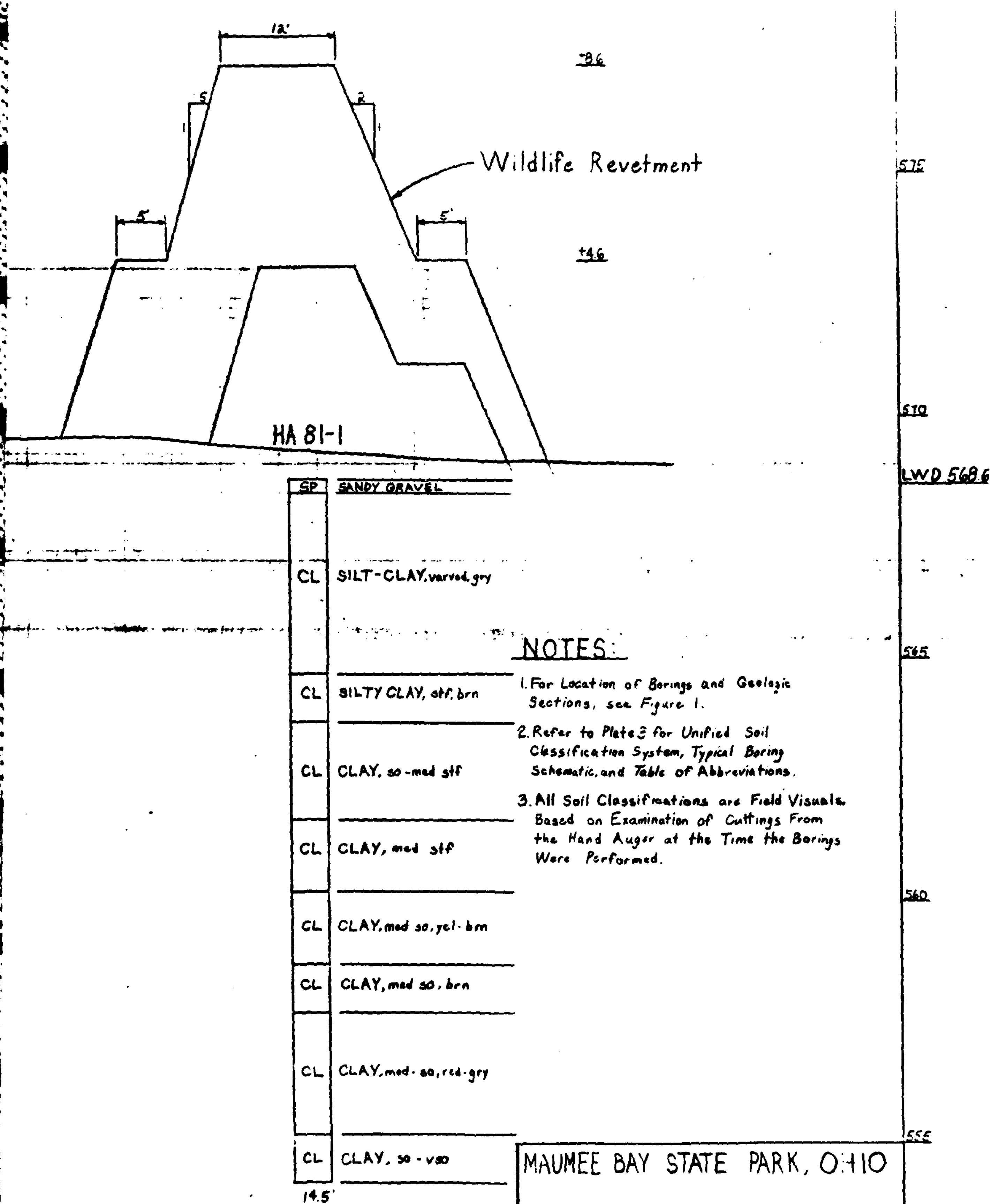

MAUMEE BAY
250' JETTY
8-300' OFFSHORE BREAKWATERS
600' CENTER TO CENTER
5300' PROTECTIVE SAND BEACH
450' WEST SHORE REVETMENT
250' REHABILITATED JETTY
6200' WILDLIFE REVETMENT
100' GAP
CEDAR POINT NATIONAL WILDLIFE REFUGE
HA81-1
HA81-2
HA81-3
ST JOHN DITCH
RELOCATED DITCH
R. AMES DITCH
BERGER DITCH
SAUTTER DITCH
McHENRY DITCH
MAUMEE BAY STATE PARK
CURTICE ROAD
NORTH
CEDAR POINT ROAD
NORDEN ROAD
MAUMEE BAY STATE PARK BOUNDARY
●HA81-1: 1981 HAND AUGER BORING
MAUMEE BAY STATE PARK
OHIO
1981 SUBSURFACE EXPLORATION PROGRAM
U S ARMY ENGINEER DISTRICT BUFFALO
JULY 1981

FIGURE 1



NOTES:

1. For Location of Borings and Geologic Sections, see Figure 1.
2. Refer to Plate 3 for Unified Soil Classification System, Typical Boring Schematic, and Table of Abbreviations.
3. All Soil Classifications are Field Visuals Based on Examination of Cuttings From the Hand Auger at the Time the Borings Were Performed.

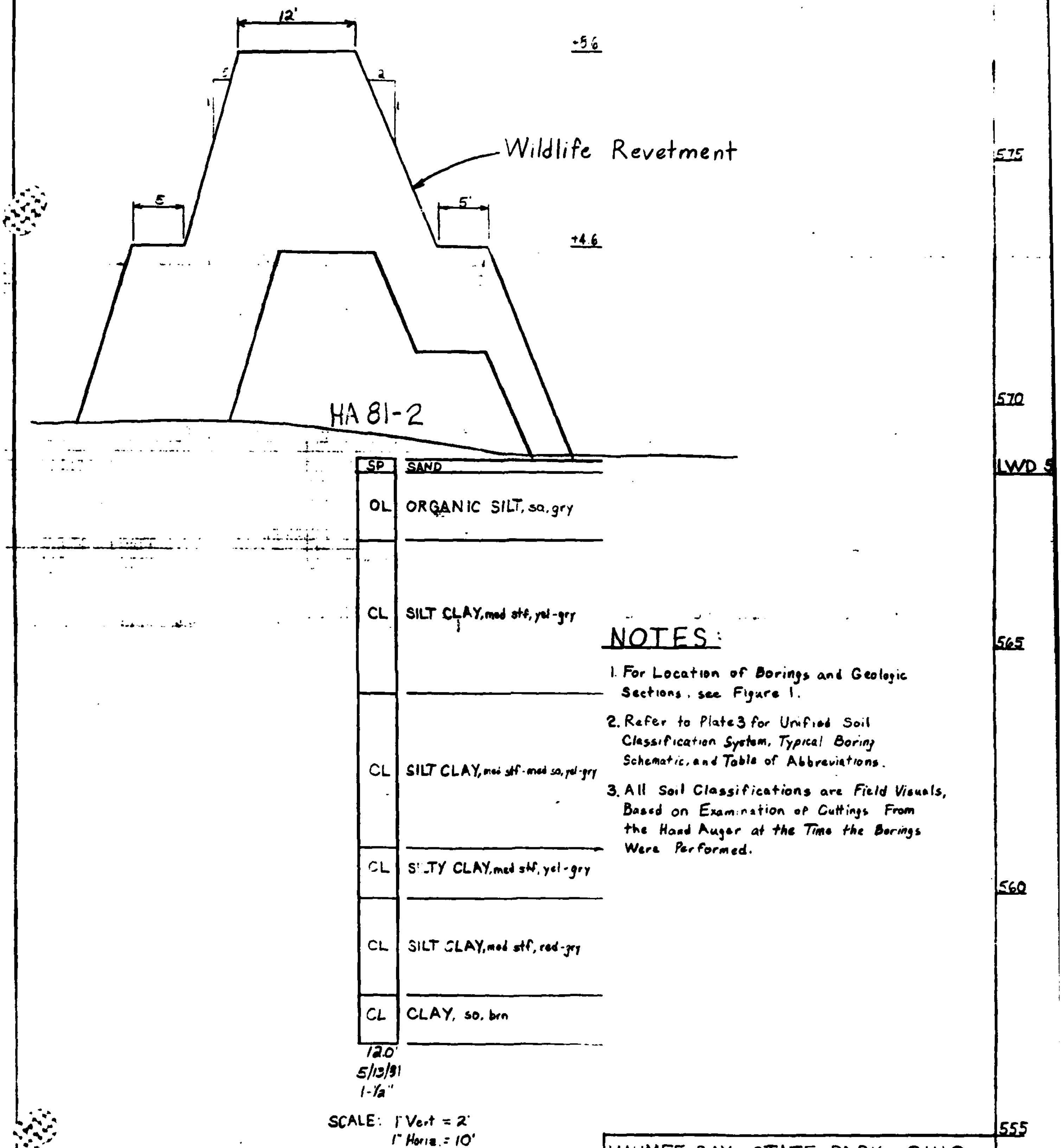
FIGURE 2

SCALE: 1" Vert = 2'
1" Horiz = 10'

MAUMEE BAY STATE PARK, OHIO

GEOLOGIC SECTION 1-1
WILDLIFE REVETMENT

U.S. ARMY ENGINEER DISTRICT BUFFALO
DECEMBER, 1981



NOTES:

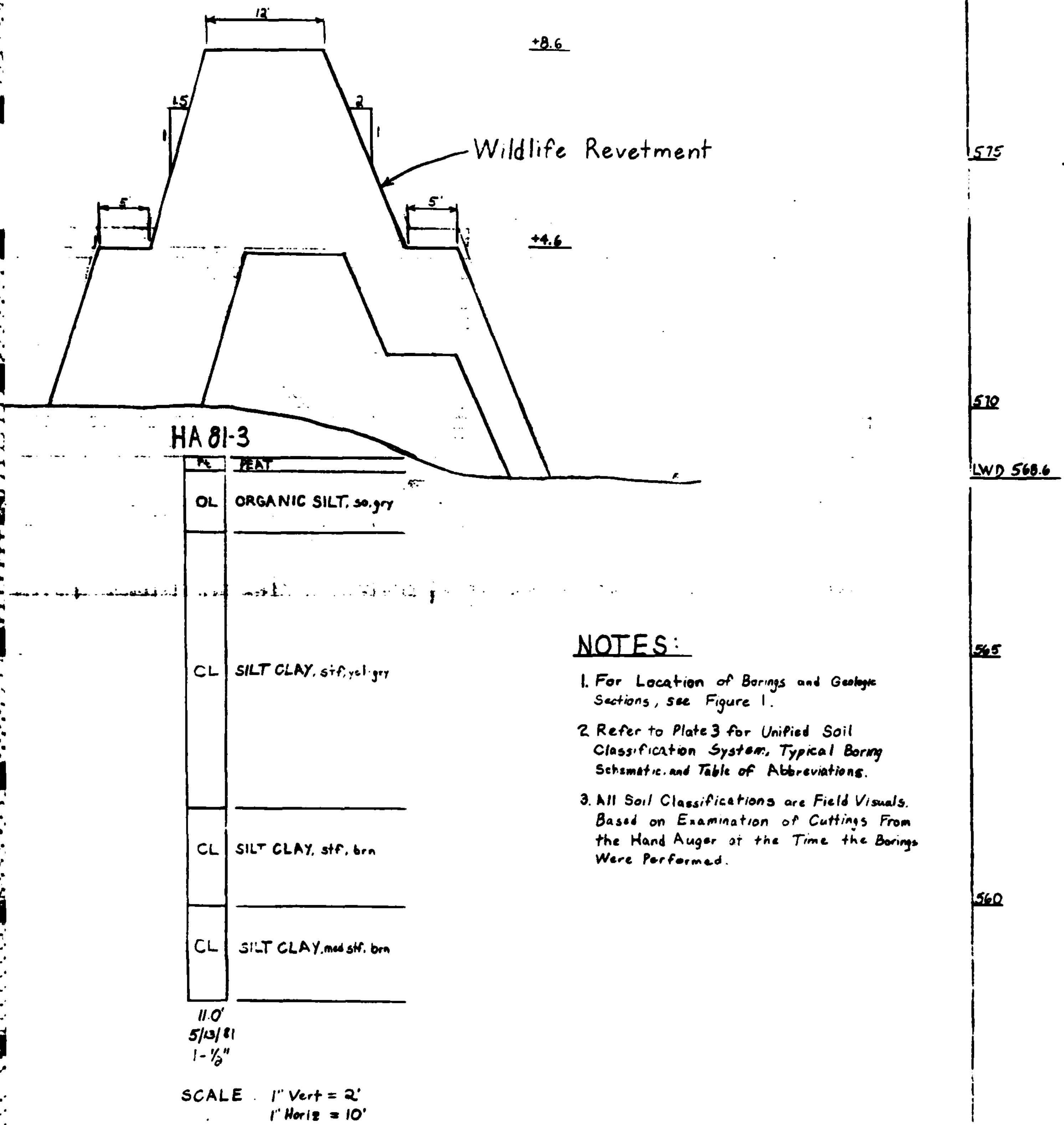
1. For Location of Borings and Geologic Sections, see Figure 1.
2. Refer to Plate 3 for Unified Soil Classification System, Typical Boring Schematic, and Table of Abbreviations.
3. All Soil Classifications are Field Visuals, Based on Examination of Cuttings From the Hand Auger at the Time the Borings Were Performed.

FIGURE 3

MAUMEE BAY STATE PARK, OHIO

GEOLOGIC SECTION 2-2
WILDLIFE REVETMENT

US ARMY ENGINEER DISTRICT BUFFALO
DECEMBER 1981



NOTES:

1. For Location of Borings and Geologic Sections, see Figure 1.
2. Refer to Plate 3 for Unified Soil Classification System, Typical Boring Schematic, and Table of Abbreviations.
3. All Soil Classifications are Field Visuals, Based on Examination of Cuttings From the Hand Auger at the Time the Borings Were Performed.

FIGURE 4

MAUMEE BAY STATE PARK, OHIO

GEOLOGIC SECTION 3-3
WILDLIFE REVETMENT

US ARMY ENGINEER DISTRICT BUFFALO
DECEMBER, 1981

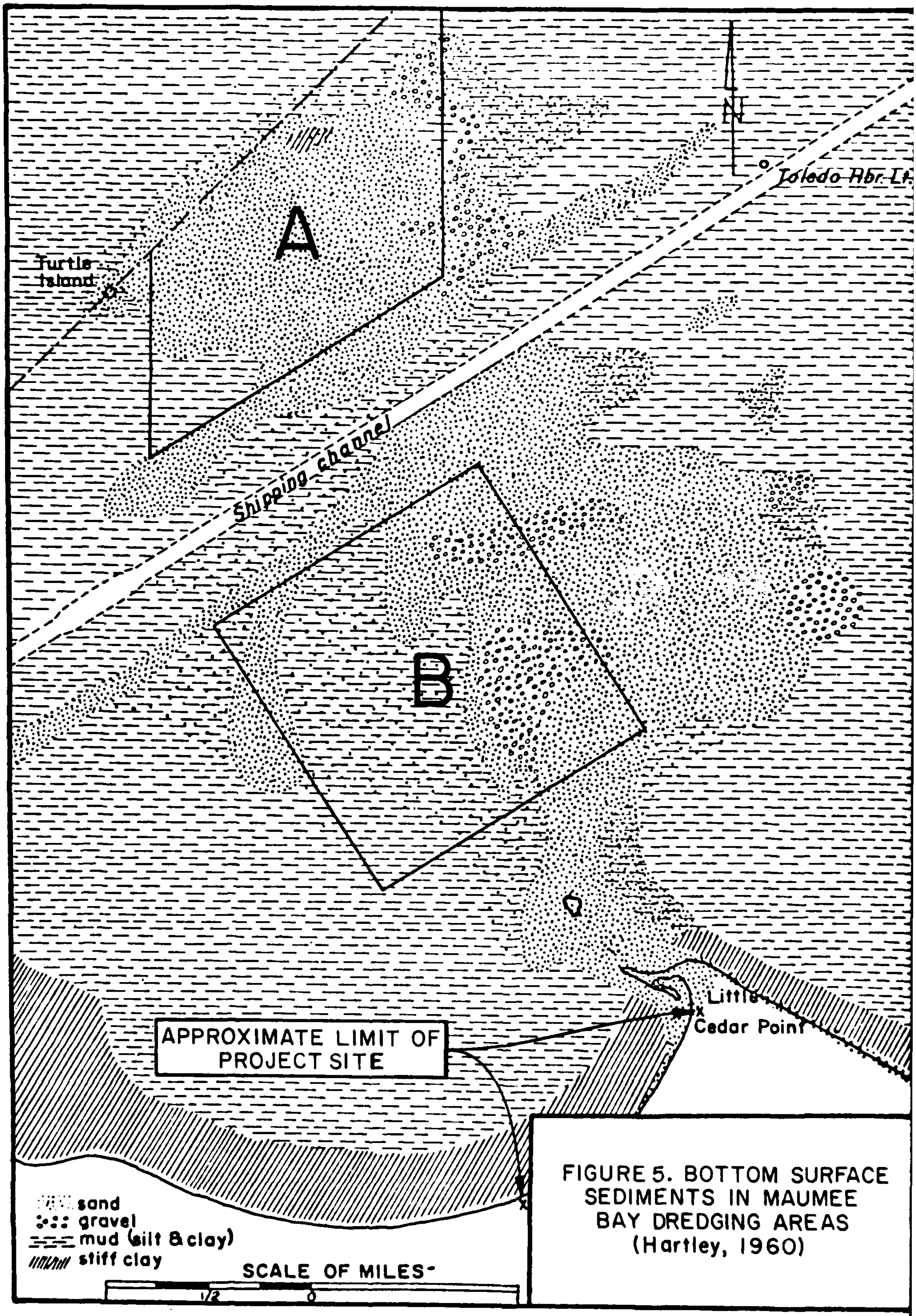


FIGURE 5. BOTTOM SURFACE SEDIMENTS IN MAUMEE BAY DREDGING AREAS (Hartley, 1960)

APPENDIX B
ECONOMIC EVALUATION

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

APPENDIX B

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TABLE OF CONTENTS (Cont'd)

TABLES

MAUMEE BAY STATE PARK, OH
FINAL FEASIBILITY REPORT

APPENDIX B
ECONOMICS

B1. INTRODUCTION

Maumee Bay State Park is located in Lucas County, OH. The park is located approximately 5 miles east of Toledo, OH. The Toledo SMSA had a population of 792,000 in 1980. Plate 1 shows the development's vicinity and location. The 1,855-acre park will provide opportunities for camping, picnicking, hiking, and fishing under current plans of continued development. However, if a beach erosion project is implemented, Ohio Department of Natural Resources will significantly expand development of the park. The expanded park would include a bathing beach, bathhouse, expanded picnicking and fishing facilities, cabins, a lodge, and a golf course, in addition to the facilities already being developed.

The economic evaluation of the proposed project alternatives is based on the increased recreational value provided by the implementation of the beach erosion control measure. Activities directly associated with the proposed alternatives include beach use (swimming, sunbathing) and jetty fishing. Additionally, the implementation of Federal shore protection will induce additional park development, i.e., lodge and cabins. Recreational activities associated with this development are dependent on total shoreline protectin in order to the realized. Five benefit categories were determined and evaluated in the analysis: recreational beach use, recreational fishing, lodge use, cabin use, and land loss prevention. The recreational benefit evaluation was accomplished using the travel cost method (TCM). This method was applied to a site specific study using the similar project technique to estimate future recreational usage at Maumee Bay State Park.

Thirty-six alternative plans of improvement were analyzed in an attempt to maximize net national economic development (NED) benefits. They are comprised of eighteen combinations of beach width and length combinations with and without segmented breakwaters. Additionally, a no-action alternative was evaluated and is used as the base case.

Total benefits associated with each of the thirty-six alternatives are calculated as the difference in the total value directly provided by each alternative plan of improvement and the total value provided by the base case.

B2. RECREATIONAL USE ESTIMATION

East Harbor State Park (EHSP), Punderson State Park, and to a limited extent, Salt Fork State Park were selected as similar sites for determining the recreational usage of Maumee Bay State Park.

a. Beach Use and Fishing.

Estimated demand for swimming and fishing at Maumee Bay State Park are based on hisotorical use patters at EHSP. EHSP is located on Lake Erie,

81 miles west of Cleveland and 45 miles east of Toledo (Plate 2). The 1,613-acre park offers a wide range of resource attributes including access to Lake Erie for swimming and fishing. EHSP was selected among all other Ohio State Parks based on similar park characteristics including type, size, and quality of the park as well as market area demographic and socioeconomic characteristics; and location of competing recreational opportunities.

The historic East Harbor State Park visitation data were analysized to determine user preferences and characteristics. The types of activities available and EHSP's estimate of use by activity were crucial inputs to the demand analysis of Maumee Bay. The travel cost method also requires visitor origin data; however, this was not available for EHSP. The origin or travel distance data is crucial in estimating the first stage demand curve in the TCM. Recreation day use visitor origin data, however, was available in a 1977 Pennsylvania Department of Environmental Resources study.

The demand for beach recreation is significantly affected by the time/distance the population served is willing to travel to engage in beach activities. Generally, as the time/distance function increases, the per capita participation rate decreases. This is due to availability of alternative beaches, alternative recreation activities, and travel and time restrictions. Several State Comprehensive Outdoor Recreation Plans (SCORP) were reviewed to determine the travel distance decay function most applicable to East Harbor State Park, Ohio. East Harbor State Park was used as a similiar park for evaluation of the Maumee Bay study. The Ohio SCORP did not present travel distance per capita data. However, the Pennsylvania SCORP did present the findings of their study of seven state parks. The percent distribution of day use visitors by zone was presented in the 1977 summer recreation origin survey.

The 1977 summer recreation origin survey administered by the Pennsylvania Department of Environmental Resources (PDER) included users of seven Pennsylvania State parks. The survey was conducted over three periods throughout the summer of 1977; 26-27 June, 21-25 July, and 16-19 August. The State parks included in the survey and a list of summer resources attributes associated with each park is presented in Table B1. The selected parks offer a multitude of summertime recreational activities normally associated with major State parks. In fact, the activities offered almost exactly parallel those activities offered by proposed fully developed Maumee Bay State Park.

The survey ascertained travel time to the park and the principle activity which attracted the user to the park. The distribution of park users by travel time was developed for park attendants who indicated a day use activity as the primary purpose for the trip. This would exclude those indicating camping or cabin users as the primary purpose. Table B2 presents the distribution of day use trips by travel time to the park as anaylzed by PDER. This relationship was converted to the distribution of day use trips by distance traveled using the average speed of 44 miles per hour.

This distribution is the basis for determining the distribution of 1980 historical beach attendance at East Harbor State Park by distance zone. The average one-way travel time by principle activity was calculated by PDER

based on the summer origin survey; results as shown in Table B3. The average one-way travel time for park participants with swimming as the primary attraction to the park was 42 minutes. The cumulative total percent of day users one-way travel time for the 31-59 minute range is 58.29 percent (Table B2). Using the day use curve as representing the relationship of percentage swimmers by travel time is supported by the fact that the average travel time for swimmers (42 minutes) is close to 50 percent of the cumulative total.

The socio-economic patterns of Ohio and Pennsylvania were compared to ensure the Pennsylvania results were appropriate for use in Ohio. Since recreation preferences are strongly associated with socio-economic characteristics, a close parallel of Ohio and Pennsylvania socio-economic patterns would support application of Pennsylvania data to the East Harbor similar park.

Ohio and Pennsylvania are adjacent, heavily industrialized, states with approximately the same population and total area. Ohio had a 1980 population of 10.8 million and area of 41,330 square miles, while Pennsylvania has 11.9 and 45,308, respectively. In addition, the water areas, as defined in the 1982-83 Statistical Abstract of the United States, Table No. 338, Area of States and Other Areas: 1980, are 325 square miles for Ohio and 420 square miles for Pennslyvania. Overall, the states are very similar, as shown in the following comparison.

Four dominant socio-economic factors in determining recreation preferences were compared. The four factors were population, employment, income, and education. A demographic profile of each state is presented in Table B4, 1980 Population Characteristics for Ohio and Pennsylvania. There is less than 9 percent difference in population, and perhaps more importantly, only a 4 percent difference in population under 45 years of age. Recreation participation rates generally decline rapidly in higher age cohorts. In addition, the states are very similiar in sex, race, and household characteristics.

Employment and labor force characteristics are also similar for 1981. Employment is strongly oriented toward manufacturing in comparison with the employment in manufacturing nationally. Pennsylvania and Ohio have 28 percent and 29 percent of their labor force employed in manufacturing, while only 22 percent of the national labor force is employed in this area. The total (number of people in the) labor force is very comparable as are the employment population ratios and participation rates for males and females. Table B5 shows employment distribution by industry and total labor force data for each State.

Family income characteristics for the two states were found to be approximately the same. Median family incomes were 2 percent apart in 1979; with Ohio ranking 16th among the states and Pennsylvania 21st. The percent distribution of families among income groups was also very similar. Income characteristics were more similar to each other than they were U.S. data. See Table B6 for Family Income Characteristics.

The education enrollment for 1980 and the years of completed schooling among persons 25 years and older (in Ohio and Pennsylvania) closely parallel to

each other as shown in Table 7. Each state has approximately the same enrollment in elementary, secondary, and higher institution. In addition, the educational status of people over 25 reflects similar attitudes and preferences. Approximately 67 percent of Ohio population over 25 completed high school and 15 percent completed college. Similar data for Pennsylvania was 65 percent and 14 percent as of 1980.

In summary, there are close parallels in Ohio and Pennsylvania socio-economic characteristics. The four broad areas compared strongly influence recreation activity preferences in the population. Since the dominant characteristics of Pennsylvania and Ohio are very similar, both absolutely and relatively, the results of the Pennsylvania study were considered more representative of Ohio recreation patterns than general curves based on national data. Also, the states are adjacent and have similar highway networks. These factors resulted in the conclusion Pennsylvania percent distribution of that day use visitors by origin zone is appropriate for use in the Maumee Bay study.

Table B1 - 1977 Summer Recreation Survey, Pennsylvania, DER State Park Summer Resource Attributes

State Park	Number Survey Questionnaires	Percentage Survey Questionnaires	Park Acreage	Nature Area	Picnicking	Play Field	Playground	Swimming Beach	Swimming Pool	Hiking Trails	Fishing[1]	Hunting	Boat Launch	Marina	Canoeing	Horseback Riding	Number Campsites	Cabins
Cook Forest	441	13.6	6,422	Y	Y	Y	N	N	Y	Y	C, W	Y	N	N	Y	Y	226	Y
Hickory Run	420	12.9	15,500	Y	Y	Y	Y	Y	N	Y	C	Y	N	N	N	N	381	N
Laurel Hill	240	7.4	3,935	N	Y	Y	N	Y	N	Y	C, W	Y	Y	N	N	N	270	N
Lyman Run	36	1.1	595	N	Y	Y	Y	Y	N	Y	C, W	Y	Y	N	N	N	50	N
Presque Isle	1,114	34.3	3,200	Y	Y	Y	N	Y	N	Y	C, W	Y	Y	Y	N	N	N	N
Pymapuning	703	21.7	21,122	Y	Y	Y	Y	Y	N	Y	W	Y	Y	Y	N	N	832	N
World's End	292	9.0	780	N	Y	Y	N	Y	N	Y	C	Y	N	N	N	N	70	Y
Total	3,246																	

[1] C - Cold-Water Fishing
W - Warm-Water Fishing

SOURCE: Pennsylvania State Parks Recreational Guide, Pennsylvania Department of Environmental Resources

Table B2 - One-Way Travel Time - Day Use (Visitor Percentage)

Travel time to Park - One Way	1977 State Park	Cumulative Total
Under 5 Minutes	0.5	0.5
5 Minutes	1.7	2.2
6-14 Minutes	3.9	6.1
15 Minutes	7.1	13.2
16-29 Minutes	14.1	27.3
30 Minutes	15.7	43.0
31-59 Minutes	15.2	58.2
1 Hour	12.2	70.4
61 Minutes - 1 Hour 59 Minutes	7.1	77.5
2 Hours - 3 hours 59 Minutes	11.4	88.9
4 Hours - 7 Hours 59 Minutes	9.4	98.3
8 Hours Plus	1.7	100.0

SOURCE: 1975 and 1977 Summer Recreation Survey of Pennsylvania State Parks and State Forests, Pennsylvania Department of Environmental Resources, June 1979

Table B3 - 1977 Summer Recreation Survey, Pennsylvania DER Average One-Way Travel Time by Principle Activity

Activity	Average One-Way Travel Time (minutes)
Canoeing	89
Power Boating	63
Row Boating	32
Sailing	51
Camping	156
Picnicking	65
Fishing	35
Swimming	42
Horseback Riding	23
Hiking	93
Playfield	29
Bicycling	31
Outdoor Games	47
Relaxing	52
Sightseeing	182
Sun Bathing	37

SOURCE: 1975 and 1977 Summer Recreation Survey of Pennsylvania State Parks and State Forests, Pennsylvania Department of Environmental Resources, June 1979

Table B4 - 1980 Population Characteristics for Ohio and Pennsylvania

	United States	Ohio	Pennsylvania
Population - 1980		10,748,000	11,864,000
Median Age		29.9	32.1
Population Under 44		6,645,000	6,945,000
Population by Sex, Race, Spanish Origin			
White			
Male		4,650,000	5,117,000
Female		4,948,000	5,535,000
Black			
Male		506,000	484,000
Female		571,000	563,000
Spanish			
Male		60,000	77,000
Female		60,000	77,000
Households 1980			
Number (000)		3,834	4,220
Persons in Hshlds (000)		10,569	11,566
Persons per Hshld		2.76	2.74

Table B5 - 1981 Employment and Labor Force Characteristics

	United States		Ohio		Pennsylvania	
Labor Force, Employment (in 000's)						
Total Labor Force	108,670		5,085		5,476	
Employed	100,397		4,595		5,018	
Employ Population Ratio	58.3		57.4		55.2	
Participation Rate						
Male	77.0		77.9		74.7	
Female	52.1		50.5		47.5	
Nonagricultural Employment (000's)						
Total	91,105	%	4,323	%	4,724	%
MFG	20,173	22	1,233	29	1,300	28
Trade	20,551	23	946	22	986	21
Gov't	16,024	18	680	16	705	15
Services	18,592	20	856	20	1,006	21
Transportation, Utilities	5,157	6	218	5	258	5
Finance	5,301	6	205	5	241	5
Construction	4,176	5	154	4	183	4

Table B6 - Family Income Distribution (1979)

	United States	Ohio	Pennsylvania
Percent Distribution			
Under 10,000	20.5	17.8	17.9
10,000 - 24,999	44.1	45.2	46.8
25,000 - 34,999	19.2	20.9	20.6
35,000 - 49,999	10.6	11.4	10.1
50,000 or more	5.6	4.7	4.6
Number of Families (000)	58,976	2,858	3,138
Median Family Income	$19,908	$20,710	$20,259
State Rank in Family Income	(X)	16	21

Table B7 - Education Characteristics (in thousands)

Education	Ohio		Pennsylvania	
Enrollment: 1980				
Elementary (000)	1,493		1,486	
Secondary (000)	708		771	
Higher (000)	489		507	
Years of School Completed[1]				
Population (000)	6,290	%	7,239	%
Years Completed				
Elementary (000)	944	100	1,319	100
High School (000)	2,488	67	2,895	65
College	932	15	996	14
Public				
Private				

[1] Persons 25 years old and older

(1) Swimming Demand. The recreation demand at Maumee Bay is based on per capita use rates developed for various distances from the park site. Per capita use rates were used to develop total beach visitation from each zone and eventually, by adjusting for the average number of occupants per vehicle, in estimating the number of vehicle trips from each distance zone. County Census population data for 1980 were used to develop the population in each of eight zones 25 miles wide around East Harbor State Park. This is the first step in the analysis for determining per capita trip rates for swimming. A 200-mile radius was established as a reasonable maximum travel distance for this analysis based on park survey data for people engaging in day use activities. Road mileage distances were measured from the centroid of each county within the 200-mile radius.

The second step in deriving beach use per capita trip rates is by distributing EHSP swimming attendance by distance zone. This is accomplished by multiplying historical attendance for swimming by the percentage distribution of day use attendance origin for each 25-mile distance zone. Swimming attendance is based on the 1980 historical attendance of East Harbor State Park.

The percentage distribution of recreation trip origins by zone is shown on Table B8. The distribution of park visitor trips by origin zone is based on a 1977 summer origin survey conducted by the Pennsylvania Department of Environmental Resources. The seven Pennsylvania State parks included in the origin survey are primarily day use parks having the same available recreation activities as Maumee Bay State Park. Estimated vehicle trips by distance zone is calculated by dividing the historical 1980 swimming attendance for each distance zone by the average occupants per car (3.5). Dividing estimated vehicle trips by the total population for each zone yields per capita trip rates by distance zone. This relationship is then multiplied by the eight 25-mile wide distance population zones constructed around Maumee Bay State Park to calculate an estimate for swimming demand at Maumee Bay State Park (Table B9). Beach demand by decade for the 50-year project evaluation period (1990-2040) is based on the projected population multiplied by the per capita trip rates. The decadal 1990-2040 projections for the eight zones surrounding Maumee Bay State Park are shown in Table B10. The population projection series was based on State and county level projections. The average annual population growth rate for the period covered in the county projections developed by the several States were used to extrapolate population projections for the entire project evaluation period. The counties within the 200-mile radius are presented by State and zone in Table B11.

(2) Demand Verification - The results of the swimming demand analysis were evaluated for reasonableness in a regional framework. Composite demand estimates from adjacent SCORP studies were reviewed to ensure State level demand estimates were compatible with Maumee Bay study results. In addition, historical visitation data for East Harbor State Park were reviewed. East Harbor State Park was the similar park whose visitation patterns served as the basis for the Maumee Bay demand analysis.

The SCORP studies for Ohio, Indiana, and Michigan were reviewed since most of the Maumee Bay visitation was expected to originate from these areas. Canadian provincial recreation demand studies were not available. The SCORP data were not additive because of conceptual and technical differences in the state studies. However, significant swimming needs, especially a natural environment swimming, were found to exist over the planning evaluation period. For example, the 1980 gross needed Design Day Capacity for Ohio planning regions was 14,300,000. Thus, the Ohio SCORP estimated that 14,300,000 people occasions demanding swimming on Design Days could not be net because of constrained capacity. The Ohio calculations included pool as well as a natural environment swimming.

An analysis of swimming demand at Maumee Bay State Park indicates that in 1990, annual demand for swimming totals 1,691,300. The analysis identifies that Zone 1 (0-25 mile distance to Maumee Bay State Park), accounts for 1,545,800 (over 90 percent) of that demand. Zone 1 includes Lucas and Ottawa

Counties (Ohio) and Monroe County (Michigan) with a total estimated 1990 population of about 680,000. As a check on the demand analysis, the 1975-1980 Ohio State Comprehensive Outdoor Recreation Plan (SCORP) was used to compare swimming facility needs estimates for a comparable area. The State's planning region 4B (Lucas, Ottawa, Wood, Sandusky, and Erie Counties) was analyzed for the excess demand verification.

The SCORP indicates that - Ohio Planning Regions 1, 2A, 4B, 6, 10A, and 10B contain the seven largest urban areas which generate the greatest number of activity occasions and have the greatest absolute swimming facility needs.

(a) Derivation of Capacity - The 1973 Facilities Inventory considered each recreation area with specific data on particular activities. Swimming capacity and needs for 1990 by Ohio Department of Natural Resources Planning Regions is presented in Table B12. Supply for recreation area 4B (counties: Lucas, Wood, Ottawa, Sandusky, and Erie) is 2,130,207 acres for swimming.[1] The 1973 daily capacity (in persons) of 85,208.2 is the product of 2,130,207 supply in acres (4B) and .04 persons per square foot of swimming area.

(b) Derivation of Demand - Peak Demand (activity occasions) is converted into daily demanded capacity by dividing activity occasions by design days in the swimming season.[3]

Example:	1,745,731	(p. 144, FIG 148)
	- 18	design days for swimming
	96,984.9	activity occasions demanded (p. 147, FIG 152)

[1] Chapter 4 Ohio SCORP 1975-1980 p. 30

[2] 5 Ohio SCORP 1975-1980 p. 38

$$\frac{2{,}500 \text{ sq. ft. } (50'\text{X}50')}{100 \text{ total daily people}} = \frac{.04 \text{ person}}{\text{sq. ft.}}$$

[3] Chapter 5 Ohio SCORP 1975-1980 p. 39 (18 design days)

Table B8 - Per Capita Trips for Swimming, East Harbor State Park

(1) Zone	(2) Distance in Miles	(3) Percent Distribution of Day Use Visitors by Zone [1]	(4) Annual Day Use Visitors with Beach	(5) Total Part. by Zone (3) X (4)	(6) Average Occupancy Per Car	(7) Vehicle Trips (5) - (6)	(8) Population by Zone	(9) Trips Per Capita (7) - (8)
1	0-25	.514	352,964	181,423	3.5	51,835	79,741	.65005
2	26-50	.277	352,964	97,771	3.5	27,935	801,178	.03487
3	51-75	.049	352,964	17,295	3.5	4,941	2,472,318	.00200
4	76-100	.041	352,964	14,472	3.5	4,135	4,307,937	.00096
5	101-125	.04	352,964	14,119	3.5	4,034	4,361,719	.00092
6	126-150	.04	352,964	14,119	3.5	4,034	3,994,994	.00101
7	151-175	.024	352,964	8,471	3.5	2,420	1,682,544	.00144
8	176-200	.015	352,964	5,294	3.5	1,513	5,051,097	.00030

[1] 1975 and 1977 Summer Recreation Survey of Pennsylvania State Parks and State Forests, Pennsylvania Department of Environmental Resources, June 1979

Table B9 - Maumee Bay State Park Swimming Demand by Decade

Zone Number	Zone in Miles	Swimming Demand						
		1980	1990	2000	2010	2020	2030	2040
1	0-25	1,473,920	1,545,845	1,618,131	1,709,194	1,815,534	1,939,872	2,085,458
2	25-50	55,405	60,036	63,907	69,300	75,317	82,033	89,551
3	50-75	23,020	23,748	23,345	23,163	23,174	23,398	23,846
4	75-100	14,424	14,872	15,036	15,316	15,722	16,258	16,919
5	100-125	7,851	8,712	9,527	10,577	11,813	13,262	14,973
6	125-150	16,293	17,192	18,295	19,425	20,682	22,099	23,695
7	150-175	15,278	16,405	17,234	18,617	20,227	22,110	24,049
8	175-200	4,221	4,494	4,736	5,079	5,499	6,027	6,682
Total		1,610,412	1,691,304	1,770,211	1,870,671	1,987,968	2,125,059	2,285,173

Table B10 - Population Projections by Zone, Around Maumee Bay State Park

Zone	Distance	1990	2000	2010	2020	2030	2040
1	0-25	679,444	711,216	751,240	797,980	852,630	916,620
2	26-50	491,958	523,665	567,880	617,170	672,220	733,830
3	51-75	3,394,276	3,336,714	3,310,620	3,312,320	3,343,950	3,408,160
4	76-100	4,425,762	4,475,042	4,558,190	4,679,500	4,838,500	5,035,590
5	101-125	2,690,314	2,942,245	3,266,810	3,648,110	4,096,650	4,624,420
6	126-150	4,863,807	5,175,720	5,494,640	5,850,770	6,251,360	6,702,790
7	151-175	3,259,621	3,423,944	3,698,838	4,018,620	4,393,155	4,778,408
8	176-200	4,294,063	4,524,552	4,853,432	5,252,860	5,759,400	6,383,960

Table B11 - Counties Surrounding Maumee Bay State Park
by State, by Zone

Zone	Distance: In Miles	Ohio	Michigan	Indiana	Pennsylvania	Canada
1	0-25	Lucas	Monroe	None	None	None
		Ottawa				
2	26-50	Fulton	Lenawee	None	None	None
		Hancock				
		Henry				
		Sandusky				
		Seneca				
		Wood				
3	51-75	Crawford	Hillsdale	None	None	None
		Defiance	Washtenaw			
		Erie	Wayne			
		Hardin				
		Huron				
		Lorain				
		Paulding				
		Putnam				
		Williams				
		Wyandot				
4	76-100	Allen	Jackson	Steuben	None	Essex
		Ashland	Livingston			
		Auglaize	Macomb			
		Cuyahoga	Oakland			
		Logan				
		Marian				
		Morrow				
		Richland				
		VanWert				
5	101-125	Champion	Branch	Allen	None	Kent
		Delaware	Eaton	Dekalb		
		Holmes	Ingham	LaGrange		
		Knox	Lapeer	Noble		
		Lake	Saint Clair			
		Medina				
		Mercer				
		Miami				
		Shelby				
		Summit				
		Union				
		Wayne				

Table B11 - Counties Surrounding Maumee Bay State Park by State, by Zone (Cont'd)

Zone	Distance: In Miles	Ohio	Michigan	Indiana	Pennsylvania	Canada
6	126-150	Ashtabula	Barry	Adams	None	Lambton
		Clark	Calhoun	Blackford		
		Coshocton	Cass	Elkhart		
		Darke	Clinton	Huntington		
		Fayette	Genesee	Jay		
		Franklin	Ionia	Wells		
		Geauga	Kalamazoo	Whitley		
		Licking	Saint Joseph			
		Madison	Sanilac			
		Montgomery	Schiawassee			
		Muskingum	Tuscola			
		Portage				
		Stark				
		Trumbull				
		Tuscarawas				
7	151-175	Butler	Bay	Delaware	None	Middlesex
		Carroll	Gratiot	Kosciusko		
		Clinton	Huron	Miami		
		Fairfield	Kent	Saint Joseph		
		Greene	Midland	Wabash		
		Hocking	Montcalm			
		Mahoning	Saginaw			
		Morgan	VanBuren			
		Perry				
		Pickaway				
		Preble				
		Ross				
		Warren				
8	176-200	Adams	Allegan	Carroll	Beaver	Elgin
		Athens	Arenac	Cass	Crawford	
		Belmont	Berrien	Fulton	Erie	
		Brown	Clare	Grant	Lawrence	
		Clermont	Gladwin	Hamilton	Mercer	
		Columbiana	Isabella	Henry		
		Guernsy	Mecosta	Howard		
		Hamilton	Muskegon	Laporte		
		Harrison	Ottawa	Madison		
		Highland		Marshall		
		Jackson		Pulaski		
		Jefferson		Randolph		
		Meigs		Starke		
		Monroe		Tipton		
		Noble		Wayne		
		Pike				
		Vinton				

Table B12 - Swimming Capacity [1]: Needs - 1990

Planning Region	1973 Capacity (1)	Demanded Capacity (2)	Net Capacity [2] Gross (3)	Net Capacity [2] Net (4)	Gross Minus Net Capacity (5)
1	40,938.7	158,819.3	119,109.9	117,880.6	1,229.3
2a	26,894.0	125,241.5	98,676.9	98,347.5	329.4
2b	21,704.5	36,140.4	16,624.9	14,435.9	2,189.0
3	22,143.8	40,367.0	18,792.3	18,223.2	569.1
4a	12,728.8	17,720.9	6,377.8	4,992.1	1,385.6
4b	85,208.2	96,984.9	46,053.4	11,776.8	34,276.6
5a	15,643.5	28,420.2	14,395.9	12,776.8	1,619.1
5b	20,201.1	28,148.0	12,412.6	7,946.9	4,465.7
6	49,257.9	162,500.5	116,846.3	113,242.6	3,603.7
7	30,657.2	37,511.5	12,354.6	6,854.4	5,500.3
8	16,977.0	23,896.9	10,278.6	6,919.9	3,368.7
9	49,760.2	52,244.0	17,625.6	2,483.7	15,141.8
10a	74,433.7	271,678.1	201,885.6	197,244.4	4,641.2
10b	72,313.2	155,683.1	85,942.6	83,369.8	2,572.8
11	62,622.2	83,096.9	26,998.2	20,474.8	6,523.4
STATE	601,480.3	1,318,445.0	804,374.2	716,967.8	87,406.4

[1] All capacity figures are daily capacity.

2 Gross needed capacity is the sum of needs of only those counties in the planning region with positive needs (i.e., a deficit capacity); the net needed capacity is the sum of needs of all counties, both those counties with positive needs and those with negative needs (i.e., a surplus capacity).

Gross needed capacity of 46,053.4 is the sum of needs of Lucas County, 1,076,531; Wood County, 74,804.9 expressed in square feet. Ottawa, Sandusky, and Erie Counties are also in planning region 4B, but they have a surplus capacity and not included in the gross neeed capacity. Given the comparatively short usual travel time for swimming, it is not likely that people could be encouraged to travel to counties with surplus capacities; therefore, the gross needed capacities (positive needs) of the planning regions are the most realistic appraisal of swimming facility needs.[4] The total of Lucas and Wood Counties, 1,151,335.9 sq. ft. X .04 persons/sq. ft., amounts to 46,053.4 gross daily needed swimming capacity (Table B13). Gross annual needed swimming capacity for 4B in 1990 is 828,961 (46,053.4 X 18 design days).

Table B13 - Swimming Facility Needs

	1990 Square Feet	Persons/ Square Feet	Gross Needed Capacity (people)
1	2,977,747.0	.04	119,109.9
2A	2,466,923.0	.04	98,676.9
2B	415,623.2	.04	16,624.9
3	469,808.3	.04	18,792.3
4A	159,444.4	.04	6,377.8
4B	1,151,335.0	.04	46,053.4
5A	359,896.5	.04	14,395.9
5B	310,316.0	.04	12,412.6
6	2,921,158.0	.04	116,846.3
8	256,965.9	.04	10,278.6
9	440,638.8	.04	17,625.6
10A	5,047,140.0	.04	201,885.6
10B	2,148,565.0	.04	85,942.6
11	674,955.1	.04	26,998.2
Total			792,020.6
			X 18 design days
			14,256,370.8 annual gross needed capacity

[4] Ohio SCORP 1975-1980, p. 145

Based on design day (peak period use) criterion, the 18 highest swimming attendance days for EHSP in 1980 were determined and compared with total annual beach attendance. The 18 peak usage days accounted for 26.1 percent of total annual attendnce. To compare the annual swimming demand for Maumee Bay State Park from Zone 1 with Ohio SCORP's calculation of gross annual needed swimming capacity, in planning region 4B, 26.1 percent of the total annual demand was calculated as annual peak demand (403,454). A direct comparison reveals that annual peak swimming demand at Maumee Bay State Park from Zone 1 would satisfy only 48.6 percent of the gross annual neeed swimming capacity in planning region 4B in 1990.

The Indiana SCORP indicated that there was a surplus in supply capacity from 1980 to 1990. However, by 1995 there would be a demand for 460,000 swimming occasions that could not be met because of limited supply.

The Michigan SCORP did not directly address the issue of excess demand or deficit supply. However, conversation with the Michigan Department of Natural Resources indicated that there is excess demand in that state.

Finally, East Harbor State Park historical park visitation was reviewed from data currently available. The historical data were significantly higher than the 352,000 beach attendance in 1980. The East Harbor State Park swimming beach was approximately 2 miles long originally. About 2 miles of stone revetment was constructed in the early 1960's for dune protection. During this time there was 150 feet of beach lakeward of the wall. The high lake level has inundated and eroded the beach back to the stone revetment and the former beach has been reduced to the form of offshore bars.

Prior to the high lake stages and severe beach erosion in the mid 1970's, beach attendance was significantly higher than in the recent past. The beach use for the year 1966-67 was 790,000. It must be noted that Ohio generated annual attendance on the basis of a fiscal year extending from 1 July to 30 June. The highest beach visitation level was reached in 1970-71 when 836,000 people attended the beach. Discussions with Park staff recently indicated that the highest single day attendance was approximately 65,000 before severe erosion greatly reduced the beach area.

During the late 1970's, 90 percent of the original beach was posted as unsafe. Swimming attendance dropped from 790,000 in 1966-67 to 634,000 in 1973-74 and to 240,000 in 1976-77. The only usable portion of the original beach was a relatively small area north of the revetment. Plate 2 indicates the original configuration of East Harbor State Park beach.

In summary, the demand developed in the Maumee Bay study appears very reasonable given SCORP data and information from several states. It also appears reasonable in terms of historic visitation at East Harbor State Park. Although 1980 beach attendance at East Harbor was only 42 percent of the 1970 attendance, it was the basis for developing Maumee Bay demand for beach visitation. Thus, the demand for beach opportunities at the Maumee Bay site appear very reliable.

(3) Beach Attendance - Projected swimming demand presented in Table B9 is calculated based on an unconstrained beach size at Maumee Bay State Park. For each of the eighteen beach width and length combinations analyzed, the total annual expected beach attendance was calculated. 1980 historical daily attendance figures for swimming at EHSP were used to simulate the distribution of annual demand at Maumee Bay on a daily basis. The daily attendance was ranked from the highest use day to the least use day and the percentage distribution for the 122 day swimming season was calculated. These daily percentages were multiplied by the total annual swimming demand at Maumee Bay State Park to estimate daily swimming demand. This is illustrated on Table B14. Length of season (122 days) is based on historical daily beach attendance data at East Harbor State Park. An analysis was performed measuring the affect of using a shorter season on demand. The 90 highest use days account for 93.0 percent of total annual participation and 100 highest use days account for 96.9 percent of total annual use. Total 1990 swimming demand at Maumee Bay is shown below assuming varied beach season lengths.

Season Length	1990 Demand
122 days	1,691,302
100 days	1,639,350
90 days	1,573,468

The daily capacity was calculated for the beach area for each alternative using a space standard of 100 square feet per person and a daily turnover rate of 1.5. Annual beach attendance for each alternative calculated as the sum of daily swimming demand. For those days where swimming demand was estimated as being greater than daily capacity, the smaller number is used in the sum. Maximum daily capacity and projected annual beach attendance by decade is presented in Table B15 for each alternative.

(4) Swimming Benefits - Recreational values have been calculated for swimming. Total recreational value by alternative is calculated by summing up consumer surplus for motor vehicle costs and opportunity costs of onsite and driving time (via travel cost method) and user fee revenues ($0 in this case). Recreational values for swimming do not increase with the implementation of the golf course, lodge, or cabins.

Table B16 presents the resultant calculated second stage demand curve for hypothetical shifts in motor vehicle costs for 1990 unconstrained by supply. The area under each curve represents the motor vehicle cost portion of consumer surplus which partially comprises the total recreational value of each alternative with no supply constraint. The average value per visit is calculated as the total area under the second stage demand curve (above actual travel cost expenditures) divided by the estimated number of annual visits (demand) with a zero distance shift ($2,204,700 - 483,229). Because the annual demand estimate is greater than the annual supply provided under each alternative, the recreational value for motor vehicle costs is calculated as the product of average value per visit and the annual attendance (trips) with supply constraint. The average variable motor cost calculated at $.137 per mile is weighted based on the distribution of retail automobile sales in the

U.S. (1974-1980) in the categories subcompact, compact, standard, and intermediate. Variable motor vehicle cost is calculated based on three components: (1) Maintenance, assessories, parts, and tires; (2) Gas and oil; and (3) Taxes as reported in Federal Highway Administrations Publication Cost of Owning and Operating Automobiles and Vans, 1982; updated to October 1983 prices. Table B17 provides the recreational value for motor vehicle costs in 1990 for each alternative with the supply constraint.

The derivation of the recreational value attributed to the opportunity cost of time unconstrained by supply for 1990 is presented in Table B18. The opportunity cost of time is the value of work or leisure activities foregone to travel to and recreate at the site. The calculation for the opportunity cost of time is similar to that for motor vehicle costs with the exception of the inclusion of on-site time. A relationship between travel time and length of stay in State parks has been established based on the 1978 Parks Visitor Survey conducted by New York State Office of Parks, Recreation, and Historic Preservation (NYSOPR). The survey was aimed at day use patrons at State parks. A regression analysis performed by NYSOPR relating length of stay with minutes of travel quantified the positive relationship between these two variables. It produced the equation, length of stay = .61 (travel time) + 263. Both variables are expressed in minutes. This relationship was utilized in travel cost method calculations for opportunity cost of time valuation for swimming. Table B18 shows the calculated second stage demand curve for hypothetical shifts in opportunity time costs for 1990 with no supply constraint. The recreational value for opportunity time costs for each alternative is calculated in the same method as motor vehicle costs. Average opportunity cost value per person is calculated as the total net willingness to pay ($3,275,300) divided by the projected swimming demand (1,619,304). The opportunity cost of time, calculated at $2.89 per hour of adults and $.72 per hour for children, is based on the average weighted total weekly earnngs in Ohio, October 1983. Opportunity cost of time is assumed one-third and one-twelfth the average hourly wage rate for adults and children, respectively. Average weighted weekly earnings in Ohio are calculated by dividing the sum of products of average weekly earnings for each sector and employment for each sector by total employment. Average hourly wage rate in Ohio is simply the average weekly earnings divided by 40 hours per week. Table B19 presents the recreational value for opportunity time cost in 1990 for each alternative with a supply constraint. Since there are no proposed entrance or user fees for day use participants at Maumee Bay State Park, no additional value is attributed to beach use.

Recreational value summaries by decade for each beach size option are presented in Table B20. Average annual equivalent values are calculated assuming straight line growth between decades using the Federal discount rate of 8-1/8 percent.

Table B14 - Projected Daily Swimming Demand at Maumee Bay State Park by Decade

MAUMEE BAY STATE PARK
1,375,000 SQ FT BEACH OCT 83 PL

ANALYSIS OF 1375000 SQ FT BEACH , TURNOVER RATE 1.5, SPACE STANDARD 100 SF/PERSON , DAILY CAPACITY 20625

EAST HBR ATTENDANCE DATA FOR 1980	PERCENT OF TOTAL	1980	1990	2000 MAUMEE BAY	2010 DEMAND BY DAY	2020	2030	2040
7636	.021634	34840	36590	38297	40470	43008	45974	49437
6016	.017046	27448	28827	30171	31884	33883	36220	38948
5970	.016937	27276	28646	29982	31684	33670	35992	38764
5606	.015883	25578	26863	28116	29712	31575	33752	36295
5524	.015650	25203	26469	27704	29276	31112	33257	35763
5500	.015582	25093	26354	27583	29149	30977	33113	35608
5410	.015327	24683	25923	27132	28672	30470	32571	35025
5275	.014945	24068	25277	26456	27957	29710	31759	34152
5180	.014698	23670	24859	26019	27495	29219	31234	33587
5096	.014438	23251	24419	25558	27009	28702	30682	32993
5060	.014336	23087	24247	25378	26818	28500	30465	32760
5058	.014330	23077	24236	25367	26807	28488	30452	32747
5050	.014307	23040	24197	25326	26764	28442	30403	32694
5010	.014194	22858	24006	25126	26552	28217	30163	32436
4980	.014109	22721	23863	24976	26393	28048	29982	32242
4938	.013990	22530	23661	24765	26171	27812	29730	31970
4875	.013812	22243	23360	24450	25838	27458	29351	31563
4865	.013783	22196	23311	24399	25783	27400	29290	31497
4810	.013628	21947	23049	24124	25494	27092	28960	31142
4786	.013560	21837	22934	24004	25366	26957	28816	30987
4755	.013472	21695	22785	23848	25202	26782	28629	30786
4700	.013316	21444	22521	23572	24910	26472	28297	30429
4669	.013228	21303	22373	23416	24745	26297	28110	30228
4650	.013174	21216	22281	23321	24644	26189	27996	30105
4612	.013067	21043	22100	23131	24444	25977	27768	29860
4470	.012664	20394	21419	22418	23690	25176	26912	28939
4365	.012367	19916	20916	21892	23135	24585	26281	28261
4355	.012338	19869	20867	21841	23080	24528	26219	28194
4260	.012069	19436	20412	21365	22577	23993	25647	27580
4228	.011979	19291	20260	21205	22409	23814	25456	27374
4175	.011828	19048	20005	20938	22126	23514	25135	27029
4104	.011627	18724	19665	20582	21750	23114	24708	26570
4064	.011514	18542	19474	20382	21539	22889	24468	26311
4009	.011358	18291	19210	20106	21247	22579	24136	25955
4000	.011333	18251	19168	20062	21200	22530	24083	25898
4000	.011333	18251	19168	20062	21200	22530	24083	25898
3879	.010990	17698	18587	19455	20559	21848	23354	25114
3870	.010964	17657	18543	19409	20510	21796	23299	25055
3855	.010922	17589	18472	19334	20431	21713	23210	24959
3830	.010851	17475	18352	19209	20299	21571	23059	24796
3800	.010766	17338	18209	19058	20140	21402	22878	24602
3800	.010766	17338	18209	19058	20140	21402	22878	24602
3640	.010313	16608	17442	18256	19292	20502	21916	23567
3605	.010214	16449	17275	18081	19107	20305	21705	23341
3600	.010199	16425	17250	18054	19079	20275	21673	23306
3518	.009967	16051	16857	17644	18645	19814	21180	22776
3422	.009695	15613	16397	17162	18136	19273	20602	22155
3400	.009633	15513	16292	17052	18020	19150	20471	22013
3360	.009519	15330	16100	16851	17807	18923	20228	21753
3176	.008998	14490	15218	15928	16832	17888	19121	20562
3090	.008754	14098	14806	15496	16376	17403	18603	20004
3040	.008613	13870	14567	15247	16112	17122	18303	19682
3025	.008570	13801	14494	15171	16032	17037	18212	19584
3010	.008528	13734	14423	15096	15953	16953	18123	19488
2940	.008330	13415	14089	14746	15583	16560	17702	19035
2935	.008315	13391	14063	14719	15555	16530	17670	19001
2933	.008310	13383	14055	14710	15545	16520	17659	18990
2930	.008301	13368	14040	14695	15528	16502	17640	18969
2930	.008301	13368	14040	14695	15528	16502	17640	18969
2924	.008284	13341	14011	14664	15497	16468	17604	18930
2872	.008137	13104	13762	14404	15222	16176	17292	18594
2864	.008114	13067	13723	14363	15179	16130	17243	18542
2830	.008018	12912	13561	14194	14999	15940	17039	18323
2820	.007990	12867	13514	14144	14947	15884	16979	18259
2810	.007961	12820	13464	14093	14892	15826	16918	18192
2742	.007769	12511	13140	13753	14533	15445	16510	17758
2700	.007650	12320	12938	13542	14311	15208	16257	17482
2670	.007565	12183	12795	13392	14152	15039	16076	17287
2590	.007338	11817	12411	12990	13727	14588	15594	16769
2585	.007324	11795	12387	12965	13701	14560	15564	16737
2580	.007310	11772	12363	12940	13675	14532	15534	16705
2570	.007281	11725	12314	12889	13620	14474	15473	16638
2540	.007196	11589	12171	12738	13461	14305	15292	16444
2540	.007196	11589	12171	12738	13461	14305	15292	16444
2510	.007111	11452	12027	12568	13302	14136	15111	16250
2499	.007080	11402	11974	12533	13244	14075	15045	16179
2470	.006998	11270	11836	12388	13091	13912	14871	15992
2430	.006885	11088	11645	12188	12880	13687	14631	15733
2416	.006845	11023	11577	12117	12805	13608	14546	15642
2328	.006573	10585	11117	11636	12296	13067	13968	15020
2160	.006120	9856	10351	10834	11449	12166	13005	13985
2042	.005785	9316	9784	10241	10822	11500	12293	13220
2020	.005723	9216	9679	10131	10706	11377	12162	13078
2000	.005666	9125	9583	10030	10599	11264	12041	12948
1988	.005632	9070	9525	9970	10536	11196	11968	12870
1986	.005627	9062	9517	9961	10526	11186	11958	12859
1874	.005309	8550	8979	9398	9931	10554	11282	12132
1868	.005292	8522	8950	9368	9900	10520	11246	12093
1762	.004992	8039	8441	8837	9338	9924	10608	11408
1720	.004874	7849	8243	8626	9116	9689	10355	11141
1700	.004816	7756	8145	8525	9009	9574	10234	11005
1680	.004760	7666	8051	8426	8904	9463	10115	10877
1660	.004703	7574	7954	8325	8798	9349	9994	10747
1523	.004315	6949	7298	7638	8072	8578	9170	9861
1508	.004272	6880	7225	7562	7992	8493	9078	9762
1482	.004199	6762	7102	7433	7855	8347	8923	9595
1220	.003456	5566	5845	6118	6465	6870	7344	7898
1143	.003238	5215	5476	5732	6057	6437	6881	7399
1043	.002955	4759	4998	5231	5528	5874	6280	6753
799	.002238	3604	3785	3962	4187	4449	4756	5114
756	.002142	3450	3623	3792	4007	4258	4552	4895
746	.002114	3404	3575	3742	3955	4203	4492	4831
729	.002065	3326	3493	3655	3863	4105	4388	4719
647	.001833	2952	3100	3245	3429	3644	3895	4189
620	.001757	2829	2972	3110	3287	3493	3734	4015
620	.001757	2829	2972	3110	3287	3493	3734	4015
614	.001740	2802	2943	3080	3255	3459	3698	3976
612	.001734	2792	2933	3070	3244	3447	3685	3962
604	.001711	2755	2894	3029	3201	3401	3636	3910
599	.001697	2733	2870	3004	3175	3374	3606	3878
551	.001561	2514	2640	2763	2920	3103	3317	3567
541	.001533	2469	2593	2714	2868	3048	3258	3503
533	.001510	2432	2554	2673	2825	3002	3209	3451
530	.001502	2419	2540	2659	2810	2986	3192	3432
500	.001417	2282	2397	2508	2651	2817	3011	3238
499	.001414	2277	2392	2503	2645	2811	3005	3231
498	.001411	2272	2386	2498	2640	2805	2998	3224
485	.001374	2213	2324	2432	2570	2731	2920	3140
54	.000153	246	259	271	286	304	325	350
46	.000130	209	220	230	243	258	276	297
30	.000085	137	144	150	159	169	181	194
28	.000079	127	134	140	148	157	168	181
TOTAL 352962	.999999	1610410	1691302	1770209	1870669	1987966	2125057	2285171

Table B15 - Projected Annual Attendance at Maumee Bay State Park Swimming Beach Alternatives (Options 2B and 3C)

Alternative		Beach	Daily	Projected Annual Beach Attendance						
Width	Length	Area	Capacity	1980	1990	2000	2010	2020	2030	2040
100	2,500	250,000	3,750	424,323	426,958	429,336	431,893	434,752	437,953	440,308
100	3,000	300,333	4,500	498,573	501,243	503,840	507,155	511,017	515,228	519,253
150	2,500	375,000	5,625	608,613	611,842	614,821	618,433	622,392	626,911	632,187
100	4,000	400,000	6,000	644,613	648,062	651,303	655,183	659,391	664,036	669,312
150	3,000	450,000	6,750	716,613	720,062	723,421	727,705	732,578	737,816	743,562
200	2,500	500,000	7,500	786,704	791,187	795,354	799,705	804,698	810,541	816,964
100	5,500	550,000	8,250	854,104	860,337	865,304	870,874	876,698	882,541	889,362
200	3,000	600,000	9,000	919,176	926,469	932,813	940,326	947,116	954,464	961,362
150	4,000	600,000	9,000	919,176	926,469	932,813	940,326	947,116	954,464	961,362
250	2,500	625,000	9,375	950,340	958,719	965,806	973,809	981,965	989,587	997,362
250	3,000	750,000	11,250	1,099,767	1,110,775	1,120,746	1,133,079	1,146,591	1,159,038	1,171,620
200	4,000	800,000	12,000	1,153,928	1,169,057	1,180,382	1,193,278	1,207,732	1,223,496	1,237,778
150	5,500	825,000	12,375	1,179,181	1,196,353	1,209,562	1,223,199	1,237,898	1,254,367	1,270,253
250	4,000	1,000,000	15,000	1,324,971	1,354,386	1,381,570	1,410,375	1,437,147	1,463,013	1,484,963
200	5,500	1,110,000	16,650	1,401,260	1,434,293	1,464,358	1,500,985	1,540,977	1,577,011	1,611,455
250	5,500	1,375,000	20,625	1,532,693	1,582,451	1,627,700	1,679,982	1,732,772	1,788,560	1,847,788
300	5,500	1,650,000	24,750	1,593,477	1,664,246	1,728,249	1,799,768	1,873,830	1,953,690	2,035,278
350	5,500	1,925,000	28,875	1,604,450	1,683,589	1,758,380	1,851,749	1,954,214	2,060,331	2,165,022

Table B16 - Maumee Bay State Park - Swimming
Second Stage Demand Curve,
1990 Motor Vehicle Cost

Distance Shift	Swimming Trips	Cost per Mile [1]	Total Cost Per Shift	Travel Cost
		$	$	$
0	483,229	.137	0.00	
				1,508,771
25	42,712	.137	6.85	
				287,176
50	14,763	.137	13.70	
				52,403
75	11,703	.137	20.55	
				104,867
100	7,329	.137	27.40	
				151,690
125	2,408	.137	34.25	
				48,375
150	1,124	.137	41.90	
				41,007
175	203	.137	47.95	
				10,429
200	0	.137	54.80	
Total Consumer Surplus				2,204,717

[1] October 1983 price level

Table B17 - Maumee Bay Recreational Value, Motor Vehicle Cost, 1990
(October 1983 Price Level)

Alternative Width	Alternative Length	Beach Area	Annual Swimming Trips	Total Annual Value [1]
				$
100	2,500	250,000	121,945	556,370
100	3,000	300,333	143,240	653,528
150	2,500	375,000	174,798	797,510
100	4,000	400,000	185,133	844,663
150	3,000	450,000	205,773	138,833
200	2,500	500,000	226,066	1,031,419
100	5,500	550,000	245,797	1,121,441
200	3,000	600,000	264,667	1,207,535
150	4,000	600,000	264,667	1,207,535
250	2,500	625,000	273,955	1,249,911
250	3,000	750,000	317,338	1,447,845
200	4,000	800,000	334,045	1,524,070
150	5,500	825,000	341,830	1,559,589
250	4,000	1,000,000	386,976	1,765,566
200	5,500	1,110,000	409,786	1,869,636
250	5,500	1,375,000	452,131	2,062,833
300	5,500	1,650,000	475,493	2,169,422
350	5,500	1,925,000	481,025	2,194,661

[1] $4.56 average value/trip

Table B18 - Maumee Bay Recreational Value Opportunity Cost 1990

Alternative Width	Alternative Length	Beach Area	Annual Attendance	Total Annual Value [1]
100	2,500	250,000	426,807	826,280
100	3,000	300,000	501,243	970,385
150	2,500	375,000	611,793	1,184,405
100	4,000	400,000	648,062	1,254,620
150	3,000	450,000	720,062	1,394,009
200	2,500	500,000	791,187	1,531,704
100	5,500	550,000	860,337	1,665,576
200	3,000	600,000	926,469	1,793,604
150	4,000	600,000	926,469	1,793,604
250	2,500	625,000	958,719	1,856,039
250	3,000	750,000	1,110,775	2,150,413
200	4,000	800,000	1,169,057	2,263,244
150	5,500	825,000	1,196,353	2,316,088
250	4,000	1,000,000	1,354,386	2,622,033
200	5,500	1,110,000	1,434,293	2,776,730
250	5,500	1,375,000	1,582,458	3,063,571
300	5,500	1,650,000	1,664,246	3,221,909
350	5,500	1,925,000	1,683,589	3,259,356

[1] $1.94 average value/person

Table B19 - Maumee Bay State Park - Swimming Second Stage Demand Curve, 1990 Opportunity Cost of Time

Distance Shift	Swimming Demand	Average Speed MPH	Average Distance of Drive (Two-Way)	Average Hours of Drive (Two-Way)	Average Hours Stay	Total Hours	Opportunity Rate/Hours [1]	Total Cost Per Shift	Travel Cost
							$	$	$
0	1,691,304	44.0	0.0	0.00	4.38	4.38	1.96	8.59	
									15,486,909
25	149,494	44.0	50.0	1.14	4.73	5.87	1.96	11.50	
									1,266.927
50	51,671	44.0	100.0	2.27	5.08	7.35	1.96	14.40	
									169,837
75	40,961	44.0	150.0	3.41	5.42	8.83	1.96	17.31	
									287,246
100	25,653	44.0	200.0	4.55	5.77	10.32	1.96	20.22	
									373,261
125	8,429	44.0	250.0	5.68	6.12	11.80	1.96	23.12	
									110,452
150	3,935	44.0	300.0	6.82	6.46	13.28	1.96	26.03	
									88,609
175	711	44.0	350.0	7.95	6.81	14.76	1.96	28.94	
									21,608
200	0	44.0	400.0	9.09	7.16	16.25	1.96	31.84	
Gross Willingness to Pay									17,804,849
Net Willingness to Pay (Consumer Surplus)									3,274,292

[1] October 1983 price level

Table B20 - Maumee Bay State Park - Swimming Recreational Value Summary (Option 2b and 3c)

Alternative		Beach	Total Recreational Swimming Value						Average Annual
Width	Length	Area	1990	2000	2010	2020	2030	2040	Equivalent Value [1]
100	2,500	250,000	1,382,600	1,386,100	1,390,300	1,396,000	1,403,200	1,408,500	1,387,700
100	3,000	300,000	1,624,100	1,627,700	1,633,500	1,641,700	1,651,700	1,661,400	1,630,200
150	2,500	375,000	1,881,900	1,985,600	1,991,300	1,999,000	2,009,200	2,022,100	1,988,100
100	4,000	400,000	2,099,100	2,103,200	2,109,500	2,117,800	2,128,000	2,140,700	2,105,800
150	3,000	450,000	2,333,100	2,336,900	2,343,900	2,353,600	2,365,300	2,379,000	2,340,100
200	2,500	500,000	2,563,200	2,569,000	2,575,400	2,585,000	2,598,000	2,613,500	2,571,500
100	5,500	550,000	2,786,900	2,794,600	2,804,200	2,815,900	2,828,500	2,844,800	2,797,900
200	3,000	600,000	3,000,900	3,012,300	3,027,700	3,041,800	3,058,700	3,074,800	3,016,900
150	4,000	600,000	3,000,900	3,012,300	3,027,700	3,041,800	3,058,700	3,074,800	3,016,900
250	2,500	625,000	3,106,100	3,119,800	3,135,400	3,154,600	3,172,200	3,190,900	3,124,700
250	3,000	750,000	3,598,100	3,619,500	3,648,500	3,682,800	3,714,600	3,747,500	3,629,200
200	4,000	800,000	3,787,500	3,812,700	3,843,000	3,879,800	3,921,900	3,959,900	3,822,600
150	5,500	825,000	3,875,800	3,906,900	3,939,300	3,976,600	4,020,600	4,063,500	3,916,000
250	4,000	1,000,000	4,387,600	4,462,400	4,541,900	4,616,500	4,689,400	4,750,300	4,480,700
200	5,500	1,110,000	4,646,300	4,729,500	4,833,500	4,949,800	5,054,400	5,154,600	4,760,700
250	5,500	1,375,000	5,126,400	5,257,200	5,410,000	5,566,000	5,732,500	5,910,900	5,299,700
300	5,500	1,650,000	5,391,200	5,581,800	5,795,600	6,018,800	6,261,600	6,510,300	5,640,300
350	5,500	1,925,000	5,454,000	5,679,200	5,963,100	6,277,100	6,603,500	6,925,500	5,767,300

[1] 8-1/8 percent interest, straight line growth between decades, October 1983 price level

(5) Land Loss Prevention for Beach Area - A portion of land (80 acres) will be protected by the 250 feet W - 5,500 feet L sand beach and offshore breakwater. Of the total 1,250 acres, 80 of these will be protected from erosion by the sand beach. At approximately $4,100 market value/land acre over a 50 year evaluation period the average annual benefits are $7,000 for land loss avoided.

(6) Recreational Fishing Demand - Lake Erie is Ohio's most important water resource for recreational boaters and anglers. Improved water quality coupled with increasing numbers of game fish, particularly in the Western Basin have created intense demand for boating and/or fishing access. Research has shown that people come from all over Ohio and the midwest to fish in Lake Erie's Western Basin. Surveys conducted by the Division of Wildlife, ODNR, indicate increased angler hours have tripled in the Western Basin, the majority being directed at the harvest of walleye. Sport fishing is expected to thrive in years ahead due to excellent hatches and high survival rates of the young. The Toledo/Maumee area receives heavy effort for both walleye and yellow perch. In 1982, approximately 280,000 angler hours were expended for shoreline fishing for yellow perch and white bass (more than 90 percent of total effort excluding river fishing).

Fishing demand at Maumee Bay is developed using the same methodology for swimming demand. 1980 historical ice free fishing attendance at East Harbor State Park and Pennsylvania day use distribution by distance was used to estimate fishing demand at Maumee Bay State Park.

(7) Estimated Fishing Attendance - Protected fishing demand is calculated based on unconstrained shore and jetty access. Capacity was calculated for each alternative based on a shoreline space standard of 100 lineal feet per person and jetty standard of 60 lineal feet per person and a daily turnover rate of 2.0.

Annual fishing attendance for each alternative is calculated as the sum of the daily demand. For those days when fishing demand is estimated as being greater than daily capacity, the smaller number is used. Table B21 shows the fishing demand at Maumee Bay State Park and estimated annual fishing attendance for each alternative.

(8) Fishing Benefit Evaluation - Total recreational fishing values by alternative are calculated by summing up consumer surplus for motor vehicle costs and opportunity costs of onsite and driving time. Because the annual demand estimate is greater than the annual supply provided under each alternative, the recreational value is calculated as the product of average value per visit and the annual attendance with supply contraint. Table B22 shows the recreational value components for each alternative.
Table B23 shows decadal recreational fishing value summaries for each alternative and average annual equivalent values assuming straight line growth between decades using the Federal discount rate of 8-1/8 percent.

Table B21 - Maumee Bay State Park
Fishing Demand and Annual Attendance

Year	Fishing Demand	Fishing Attendance: 5,500 Foot-Shore [1]	Fishing Attendance: 5,500 Foot-Shore 1,000 Foot-Jetties	Fishing Attendance: 5,500 Foot-Shore 1,400 Foot-Jetties
1990	1,158,016	31,269	41,146	45,066
2000	1,212,039	31,290	41,170	45,108
2010	1,280,814	31,314	41,209	45,157
2020	1,361,121	31,346	41,261	45,209
2030	1,454,982	31,370	41,321	45,269
2040	1,564,614	31,384	41,366	45,325

[1] Maximum Daily Capacity 110 Persons.

Table B22 - Maumee Bay State Park
Recreational Values
October 1983, Price Levels
Fishing Alternatives

Year	Alternative 1		5,500 Foot-Shore 1,000 Foot-Jetties		5,500 Foot-Shore 1,400 Foot-Jetties	
	Motor Vehicle Value [1]	Opportunity Cost Value [2]	Motor Vehicle Value [1]	Opportunity Cost Value [2]	Motor Vehicle Value [1]	Opportunity Cost Value [2]
	$	$	$	$	$	$
1990	40,759.85	60,533.78	53,634.70	79,654.70	58,744.60	87,243.40
2000	40,664.20	60,391.60	53,504.80	79,460.70	58,621.90	87,061.20
2010	40,576.90	60,261.10	53,398.10	79,303.20	58,513.90	86,900.70
2020	40,516.00	60,171.50	53,332.20	79,204.30	58,435.20	86,782.90
2030	40,458.30	60,085.00	53,291.40	79,144.70	58,383.10	86,706.60
2040	40,397.20	59,994.00	53,245.70	79,075.80	58,341.00	86,643.80

1 Fishing Attendance from Table B21 - 3.5 People/Car (X) $4.56 average value/visit.

2 Fishing Attendance from Table B21 X 1.94 Average Value/Person. 6

Table B23 - Maumee Bay State Park
Recreational Fishing Value Summary
October 1983, Price Levels

Plan	Total Recreational Fishing Value 1990	2000	2010	2020	2030	2040	Average Annual Equivalent Value
	$	$	$	$	$	$	$
Alternate 1	101,294	101,056	100,838	100,688	100,543	100,391	101,026
5,500 Foot-Shore 1,000 Foot-Jetties	133,289	132,966	132,701	132,537	132,436	132,322	132,946
5,500 Foot-Shore 1,400 Foot-Jetties	145,988	145,683	145,415	145,218	145,090	144,985	145,651

b. Cabins and Lodges.

(1) Demand Verification - The cabins and lodge per capita trip rates are based on a sampling of the 1979 Punderson State Park, Ohio registration records. A 10 percent sample of registration records was taken covering the following data: origin, length of stay, and number of people. There were 1,097 lodging receipts and 41 cabin receipts. Receipts from April 1979 through October 1979 were sampled. The lodge visitor origin data was used to derive per capita trip rates, by zone. The total number of annual visitors in 1979 to Punderson State Park Lodge was divided by the average length of stay and the average number of persons per car to determine the total number of vehicle trips. The total number of vehicle trips (7,331) was multiplied by the origin distribution by zone determined in the sample to obtain the estimated number of trips from each zone. The total number of vehicle trips from each zone was divided by the population, by zone, to obtain per capita lodge trips by zone. Table B8 shows data by zone used to obtain trips per capita.

The total 1979 attendance for Punderson State Park Lodge was adjusted to reflect the significantly larger capacity planned for Maumee Bay State Park Lodge. The Punderson Lodge has 32 rooms while 150 rooms are planned for the Maumee Lodge. The capacity adjustment was made in accordance with Principles and Standards procedures for evaluating recreation under the travel cost method. Per capita use curves have been adjusted to account for differences between the similar project (Punderson) and the proposed project (Maumee). The inherent subjectivity of this manual adjustment was recognized during the evaluation. However, the significant difference in the number of rooms available made this adjustment necessary. The selected park for comparison is Salt Fork Lake State Park which offers 148 lodge rooms and 54 cabins. July registration data was used in the adjustment procedure to derive the potential lodge demand at Maumee Bay State Park. The average occupants per room and the average occupancy rate per day during July at Salt Fork Lake State Park and Punderson State Park were determined for peak and nonpeak days. The occupancy rate was defined as the percentage of rooms rented at any given time. Maumee Bay State Park is planned to have 150 lodge rooms and 50 cabins. The average of occupancy rates for Punderson Lodge and South Fork Lodge were used in this evaluation. A similar averaging was made for occupants per room. The number of lodge rooms at Maumee Bay State Park was multiplied by the average occupancy rate and the average occupants per room. This yielded the potential demand at Punderson State Park with the larger supply capacity. The actual attendance at the Punderson State Park Lodge was 7,286 in 1979. An average peak day daily attendance of 318 was estimated for Maumee Bay State Park Lodge. The peak day average occupancy rate of 75 percent was multiplied by the number of rooms available. The result was then multiplied by the 2.81 average occupants per room. The average nonpeak day capacity was 64 percent and the average number of occupants per room was 3.33. The adjusted demand is 54,869 for the Punderson State Park 150-room lodge. The potential demand of 54,869 was divided by a 2.52 persons per car and a 2.97 day average length of stay to estimate the 7,331 annual vehicle trips.

In 1979, 14,107 visitors stayed in 26 cabins at Punderson State Park. This was obtained from park records. Dividing the visitation by the peak and nonpeak supply factors, average occupancy rate and the average number of occupants per room, yields a potential monthly demand. The monthly demand was then summed to an annual demand of 21,086 for Punderson State Park cabins. However, Maumee Bay State Park will have 50 cabins as opposed to 26 cabins at Punderson. The potential demand of 21,086 was then adjusted to account for the significant difference in capacity. The potential demand of 21,086 was divided by a 4.87 average occupancy per vehicle and 4.38 days average length of stay to yield an annual total of 989 vehicle trips. The adjusted potential demand for cabins in 1979 as shown in Table B9 is then used to derive the per capita trips rates for Punderson State Park cabins. The cabin trips origin distribution shown in Table B9 was based on the lodge receipt sampling survey conducted for Punderson State Park. The zone trip demand divided by the population within the 25-mile distance zone yields the per capita trip rate for cabins and lodge shown in Tables B24 and B25.

(2) Benefits.

(a) Lodge - Recreational benefits associated with the construction of a 150 room lodge have been calculated based on travel cost method procedures. The average annual recreational values for the lodge are shown in Table B26. The average annual equivalent benefits amount to $219,000. This is based on opportunity cost of time in travel (does not include onsite time) and the variable vehicle cost. User fee revenues generated from the lodge are excluded from total recreational benefits.

(b) Cabins - ODNR also has plans to construct 50 cabins at a cost of around $1.1 million. Recreational values for cabins are shown in Table B27. The benefits are calculated using the travel cost approach. Average annual equivalent benefits for the cabins total $33,800. Like the lodge analysis, user fee revenues for the cabins are excluded for recreational benefits.

(c) Land Loss Prevented Benefits - Since a portion of the lands to be protected from shoreline erosion are wetlands, it was concluded that the monetary value of these lands is greater than the market value of about $4,000 per acre. To establish the monetary value of the estimated 60 acres adversely impacted without the project, the cost to create a similar environment through structural measures was used as a proxy. This approach seems reasonable since the Corps and others often use this practice to mitigate loss of wetlands in water resources development projects.

The principle construction features of the proxy wetlands project are a low height earthen berm and a control structure. The first cost including lands for this proxy project is estimated at $519,000. The total annual charges, including O&M, for this proxy project are $54,000. Therefore, on the basis that this proxy project is a reasonable estimate of the value of the wetlands, the annual "land loss prevented" benefits allocable to the revetment are $54,000.

(d) Cut-Off Wall Benefits - Without the revetment, a 600-foot on-shore cut-off wall would be required at the eastern end of the sand beach to prevent flanking of the beach as the unprotected portion of the shoreline recedes. Similarly, the existing U.S. Fish and Wildlife Service "Cedar Point Wildlife Refuge" revetment will require like construction as the now unprotected shoreline immediately to the west recedess. The wetland revetment under consideration for Maumee Bay State Park would eliminate the need for both of these cut-off walls. On this basis, it is concluded that eliminating the cost of these two cut-off walls with construction of the revetment is a benefit allocable to the revetment. The first cost of the walls is $500,000 and the annual charges, including O&M are $61,000. Thus, the annual benefits allocable to the revetment are $61,000.

Table B24 - Lodge Per Capita Trip Rates, Punderson State Park

(1) Zone	(2) Distance in Miles	(3) Percent of Lodge Visitors by Zone [1]	(4) Annual Lodge Visitors	(5) Total Part. by Zone (3) X (4)	(6) Average Occupancy Per Car	(7) Average Length Stay	(8) Vehicle Trips (5)-(6)-(7)	(9) Population by Zone	(10) Trips Per Capita (8)-(9)
1	0-25	.09	54,869	4,938	2.52	2.97	660	658,289	.0010025992
2	26-50	.44	54,869	24,142	2.52	2.97	3,226	3,154,979	.0010225108
3	51-75	.03	54,869	1,646	2.52	2.97	220	863,069	.0002549043
4	76-100	.07	54,869	3,841	2.52	2.97	513	2,800,492	.0001831821
5	101-125	.02	54,869	1,097	2.52	2.97	147	1,368,516	.0001074156
6	126-150	.19	54,869	10,425	2.52	2.97	1,393	2,471,439	.0005636392
7	151-175	.02	54,869	1,097	2.52	2.97	147	1,198,127	.0001226915
8	176-200	.01	54,869	549	2.52	2.97	73	2,842,636	.0000256804
								15,357,547	
Outside	+200	.13	54,869	7,134	2.52	2.97	953	206,144,453	.000004623

[1] Based on Punderson State Park sampling of registration origin data conducted by our District staff.

Table B25 - Cabin Per Capita Trip Rates, Punderson State Park

(1) Zone	(2) Distance in Miles	(3) Percent of Cabin Visitors by Zone [1]	(4) Annual Trips for Cabins	(5) Total Part. by Zone (3) X (4)	(6) Average Occupancy Per Car	(7) Average Length Stay	(8) Vehicle Trips (5)-(6)-(7)	(9) Population by Zone	(10) Trips Per Capita (8)-(9)
1	0-25	.09	21,086	1,898	4.87	4.38	89	658,289	.000135199
2	26-50	.44	21,086	9,278	4.87	4.38	435	3,154,979	.0001378773
3	51-75	.03	21,086	633	4.87	4.38	30	863,069	.0000347597
4	76-100	.07	21,086	1,476	4.87	4.38	69	2,800,492	.0000246385
5	101-125	.02	21,086	422	4.87	4.38	20	1,368,516	.0000146144
6	126-150	.19	21,086	4,006	4.87	4.38	188	2,471,439	.0000760690
7	151-175	.02	21,086	422	4.87	4.38	20	1,198,127	.0000166927
8	176-200	.01	21,086	210	4.87	4.38	10	2,842,636	.0000035179
								15,357,547	
Outside	+200	.13	21,086	2,741	4.87	4.38	129	206,144,453	.0000006258

[1] Based on Punderson State Park sampling of origin data conducted by our District staff.

Table B26 - Maumee Bay State Park
Average Annual Recreational Lodge Values
October 1983, Price Levels
8-1/8 Interest Rate

Year	Estimated Annual Participation	Motor Vehicle Cost	Opportunity Cost	Total Value
		$	$	$
1990	16,128	103,544	105,594	209,138
2000	16,853	106,743	108,861	215,604
2010	17,741	111,215	113,418	224,633
2020	18,774	116,750	119,069	235,819
2030	19,986	123,500	125,954	249,454
2040	21,382	131,569	134,173	265,742

Table B27 - Maumee Bay State Park
Average Annual Recreational Cabin Values
October 1983, Price Levels
8-1/8 Interest Rate

Year	Estimated Annual Participation	Motor Vehicle Cost	Opportunity Cost	Total Value
		$	$	$
1990	4,213	14,017	18,300	32,317
2000	4,404	14,452	18,872	33,324
2010	4,637	15,062	19,665	34,727
2020	4,899	15,795	20,615	36,410
2030	5,221	16,699	21,798	38,497
2040	5,587	17,812	23,255	41,067

B3 AVERAGE ANNUAL BENEFITS FOR THE SELECTED PLAN 3c (250'W - 5,500'L)

From the tabulation below the total average annual benefits, based on October 1983 prices, a 50-year project life and 8-1/8 percent interest rate, are $5,700,000.

Benefit Category	Annual Benefit
	$
Recreational Beach Benefits	5,300,000
Land Loss Prevented for Beach	7,000
Jetty Fishing Benefits	31,900
Revetment	
Land-Loss Prevented	54,000
Cut-Off Walls Eliminated	61,000
Lodge Benefits	219,000
Cabin Benefits	34,000
Total Project Benefits	$5,699,900 SAY 5,700,000

APPENDIX C
COST ESTIMATES

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

- First Cost and Apportionment of Costs for Selected Plan 3c (250'WX5,500'L) (October 1983 Price Levels)

Item	Quantity	Unit	Unit Price	Traditional Apportionment: Total Cost	Federal - 70 Percent (1)	Non-Federal - 30 Percent(2)
			$	$	$	$
FEDERAL PROJECT - Plan 3c (250'WX5,500'L):						
Clearing and Grubbing	8	Acres	3,650.00	29,200	20,440	8,760
Ditch Excavation	1,670	C.Y.	5.85	9,770	6,839	2,931
Stripping	22,800	C.Y.	7.95	181,260	126,882	54,378
Sandfill	300,000	Tons	5.95	1,785,000	1,249,500	535,500
Earthfill	45,200	C.Y.	2.60	117,520	82,264	35,256
Armor Stone (1-3 Tons)	31,100	Tons	37.25	1,158,475	810,933	347,542
Armor Stone (1,200-2,800 Lbs.)	5,400	Tons	43.65	235,710	164,997	70,713
Armor Stone (700-1,500 Lbs.)	46,750	Tons	43.65	2,040,638	1,428,447	612,191
Underlayer Stone (80-280 Lbs.)	1,900	Tons	31.40	59,660	41,762	17,898
Underlayer Stone (50-150 Lbs.)	23,700	Tons	31.40	744,180	520,926	223,254
Underlayer Stone (3-30 Lbs.)	25,900	Tons	25.00	647,500	453,250	194,250
Aids to Navigation	-	L.S.	-	87,200	87,200 (1)	-
Concrete Walkway (4)	500	L.F.	61.00	30,500	15,250	15,250
Filter Fabric	36,000	S.Y.	7.15	257,400	180,180	77,220
Topsoil	4,500	C.Y.	11.25	50,625	35,438	15,187
Seeding	8	Acres	1,750.00	14,000	9,800	4,200
Mobilization and Demobilization	-	L.S.	-	150,000	105,000	45,000
Total Contractor's Earnings				7,598,638	5,345,208	2,253,430
Contingencies at 25 ± Percent				1,901,362	1,334,792	566,570
Total Contractor's Earnings Plus Contingencies				9,500,000	6,680,000	2,820,000
Engineering and Design				900,000	630,000	270,000
Supervision and Administration				1,190,000	833,000	357,000
Lands				240,000	-	240,000 (2)
Total First Cost of Construction				11,830,000	8,136,900	3,693,100
Land Development (2)(3):					-	
Bathhouses				810,000	-	510,000
Parking Facilities				1,260,000	-	1,260,000
				750,000	-	250,000
				100,000	-	100,000
Utilities				250,000	-	250,000
Lands				160,000	-	160,000
TOTAL COST, ODNR DEVELOPMENT				3,330,000	-	3,330,000
TOTAL COST, FEDERAL PROJECT AND ODNR DEVELOPMENT				15,160,000	8,136,900	7,023,100

(1) Total Federal Cost.

(2) Total Non-Federal Cost.

(3) Does not include the cost for the lodge/cabin complex which are self-liquidating.

(4) Concrete walkway is for recreational fishing from the jetties, so it is cost-shared 50-50.

Annual Charges for Plan 3c (250'W X 5,500'L) (October 1983 Price Levels)

Item	Total Annual Costs (1)	Traditional Apportionment (2) Federal Annual Costs	Non-Federal Annual Costs
	$	$	$
FEDERAL PROJECT			
First Cost Alternative 3c (250'WX5,500'L)	11,830,000	8,136,900	3,693,100
Interest during Construction (.08187)	970,000	670,000	300,000
Total Investment Cost	12,800,000	8,806,900	3,993,100
Annual Charges			
Interest and Amortization (0.08292)	1,061,000	730,000	331,000
Beach Nourishment (3) (5,000 cy)	45,000	31,500	13,500
Beach Monitoring (4)	14,000	9,800	4,200
Maintenance of Structures (5)	156,000	-	156,000
Total Annual Charges, Federal Project	1,276,000	771,300	504,700
ODNR DEVELOPMENT (6)			
First Cost	3,170,000	-	3,170,000
Lands	160,000	-	160,000
Total First Cost, ODNR Development	3,330,000	-	3,330,000
Annual Charges			
Interest and Amortization	276,000	-	276,000
Operations and Maintenance	125,000	-	125,000
Total Annual Charges, ODNR Development	401,000	-	401,000
Grand Total Annual Charges-Federal Project Plus Associated ODNR Development	1,677,000	771,300	905,700

(1) Based on 50-year project life and 8-1/8 percent interest rate.
(2) Based on traditional cost sharing, 70 percent Federal and 30 percent non-Federal except lands which are 100 percent non-Federal and Aids to Navigation which are 100 percent Federal.
(3) Annual beach monitoring costs consist of $45,000 per year for first 3 years of project, and $45,000 once every 10 years thereafter.
(4) Beach nourishment to be performed for the life of the project, apportioned 70 percent Federal and 30 percent non-Federal.
(5) 100 percent non-Federal.
(6) 100 percent non-Federal costs.

Table D1 - First Cost and Apportionment - Alternative 3b (Modified) (2,500-foot Protective Sand and Turf Beach, Offshore Breakwaters and Revetments) (1) (February 1983 Price Levels)

Item	Quantity Unit	Unit Price	Total Cost	Traditional Apportionment Federal - 70 Percent (2)	Non-Federal - 30 Percent
		$	$	$	$
Clearing and Grubbing	8 Acres	3,535.00	28,300	19,800	8,500
Stripping	14,000 C.Y.	7.70	107,800	75,500	32,300
Sand Fill	116,000 Tons	5.75	667,000	466,900	200,100
Earth Fill	37,500 C.Y.	2.50	93,800	65,700	28,100
Armor Stone 1-3 Tons	15,600 Tons	36.00	561,600	335,100	168,500
Armor Stone 1,200-2,800 Lbs.	4,000 Tons	42.25	169,000	118,300	50,700
Armor Stone 700-1,500 Lbs.	46,750 Tons	42.25	1,975,200	1,382,600	592,600
Armor Stone 750-1,700 lbs.	20,300 Tons	41.05	833,300	583,300	250,000
Underlayer Stone 80-280 Lbs.	2,800 Tons	30.40	85,100	59,600	25,500
Underlayer Stone 50-170 Lbs.	11,800 Tons	29.55	348,700	244,100	104,600
Underlayer Stone 50-150 lbs.	23,700 Tons	30.40	720,500	504,400	216,100
Underlayer Stone 3-30 lbs.	12,100 Tons	24.20	292,800	205,000	87,800
Concrete Walkway	500 L.F.	59.05	29,500	20,700	8,800
Filter Fabric	52,600 S.Y.	6.90	362,900	254,000	108,900
Topsoil	2,900 C.Y.	10.90	31,600	22,100	9,500
Seeding	5.5 Acres	1,690.00	9,300	6,500	2,800
Mobilization and Demobilization	L.S.	128,000	128,000	89,600	38,400
Subtotals (3)	-	-	6,444,400	4,511,200	1,933,200
Aids to Navigation	L.S.	84,500	84,500	84,500	-
Subtotals	-	-	6,528,900	4,595,700	1,933,200
Contingencies at 25 Percent	-	-	1,631,100	1,148,900	482,270
Engineering and Design	-	-	780,000	548,700	231,300
Supervision and Administration	-	-	900,000	633,200	266,800
Lands (3)	-	-	468,000	-	468,000
Total First Cost of Construction	-	-	10,308,000	6,926,500	3,381,500

(1) Costs except for lands and Aids to Navigation taken from Appendix C.

(2) 70 percent of all items are Federal cost-shared, except lands which is 100 percent Non-Federal and Aids to Navigation, which is 100 percent Federal.

(3) Subtotal of Items subject to cost sharing.

(4) Assessed value of 120 acres of parkland needed for shore protection and parking needed for the beach at $3,900 per acre.

R 6/83

Table D2 - Annual Charges For Alternative 3b (Modified) (2,500-foot Protective Sand and Turf Beach, Offshore Breakwaters and Revetments) (February 1983 Price Levels)

Item	Total Cost	Traditional Apportionment Federal 70 Percent	Traditional Apportionment Non-Federal 30 Percent
	$	$	$
First Cost Alternative 3b (Modified)	10,308,000	6,926,500	3,381,500
Interest During Construction	718,100	505,500	212,600
Total Investment Cost Alternative 3b	11,026,100	7,432,000	3,594,100
Annual Charges (1)			
Interest and Amortization (7.875 Percent)	888,400	598,800	289,600
Maintenance Beach Nourishment (2) 2,500 C.Y. at 8.60	21,500	15,100	6,400
Monitor Beach Configuration (3)	20,000	14,000	6,000
Structures Maintenance (4)	117,000	-	117,000
Total Annual Charges Alternative 3b (Modified)	1,046,900	627,900	419,000
ODNR Development First Cost	5,000,000	-	5,000,000
Lands (5)	820,000	-	820,000
Total First Cost ODNR Development w/Lands	5,820,000	-	5,820,000
Annual Charges (1)			
Interest and Amortization (7.823 Percent)	468,900	-	468,900
Operations and Maintenance (4)	210,000	-	210,000
Total Annual Charges ODNR Development (6)	678,900	-	678,900
Grand Total Annual Charges Alternative 3b (Modified) and ODNR Development	1,725,8000	627,900	1,097,9000

(1) Based on 50-year project life and 7-7/8 percent interest rate in effect for Fiscal Year 1983.

(2) Cost shared for a 5-year trial period as suggested by ER1105-2-20, dated 20 January 1982.

(3) Cost to monitor beach configuration for 5 years following project completion.

(4) Maintenance of structures and ODNR facilities is 100 percent non-Federal cost.

(5) Assessed value of 200 acres of parkland required for ODNR development at $4,100/acre.

(6) Annual charges for ODNR development and land costs are 100 percent non-Federal.

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT: Miami Bay State Park Study (Trucked Sand) (On-Site Earth Fill)

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	ALTERNATIVE NO. 2a				
1.	Clearing and Grubbing	8	Acre	3,140.00	25,120
2.	Ditch Excavation	1,670	c.y.	5.00	8,350
3.	Stripping	16,200	c.y.	6.85	110,970
4.	Sand Beach Nourishment	418,000	TON	5.10	2,131,800
5	Compacted Earth Fill	42,500	c.y.	2.25	95,625
6.	Armor Stone 1200-2800 #	7,000	Ton	37.50	262,500
7.	Armor Stone 700-1500 #	46,750	Ton	37.50	1,753,125
8	Underlayer Stone 80-280 #	3,000	Ton	27.00	81,000
9	Underlayer Stone 50-150 #	23,700	Ton	27.00	639,900
10	Concrete Walkway	450	L.F.	52.45	23,603
11.	Filter Fabric	37,500	s.y.	6.15	230,625
12	Topsoil	4,700	c.y.	9.70	45,590
13.	Seeding	9	Acre	1500.00	13,500
14.	Mobilization and Demobilization		L.S.		108,000
	TOTAL CONTRACTOR'S EARNINGS				5,523,703
	CONTINGENCIES @ 25% ±				[illegible]
	TOTAL CONTRACTOR'S EARNINGS PLUS CONTINGENCIES				[illegible]
	ENGINEERING AND DESIGN				674,000
	SUPERVISION AND ADMINISTRATION				767,000
	TOTAL FIRST COST OF CONSTRUCTION				8,350,000
	ANNUAL MAINTENANCE COST				266,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

Rapp/2 Oct 81

Page ___ of ___ page

Subject Maumee Bay State Park Study (Trucked Sand + On-Site Earth Fill)
Computation of E&D, S&A and Maintenance Costs - Alternative 2a
Computed by Repp Checked by Date 2 Oct 81

TOTAL CONTRACTORS EARNINGS PLUS CONTINGENCIES		6,909,000
Engineering & Design		
6,912,000 (0.0975)		674,000
Supervision & Administration		
S&I: 6,912,000 (0.07) =	484,000	
Overhead		
E&D 674,000 (0.19)	128,000	
S&I 484,000 (0.32)	155,000	
		767,000
	8,350,000	

Annual Maintenance Costs

(6,909,000 - 2,131,800)/50 yrs =	95,500
Sand Beach Nourishment + Back Passing =	170,500
	266,000

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Maumee Bay State Park Study On Site Earth Fill (Trucked Sand)					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Alternative No. 3A				
1	Clearing & Grubbing	8	Acre	3,130.00	25,1[illegible]
2	Common Excavation	52,000	C.Y.	1.75	91,000
3	Stripping	14,200	C.Y.	6.85	97,270
4	Sand Beach Nourishment	316,000	Ton	5.10	1,611,600
5	Compacted Earth Fill	47,000	C.Y.	2.25	105,750
6	Armor Stone 1-3 Ton	31,100	Ton	32.00	995,200
7	Armor Stone 1200-2800#	5,400	Ton	37.50	[illegible],500
8	Armor Stone 700-1500#	46,750	Ton	37.50	1,75[illegible]
9	Underlayer Stone 80-280#	1,900	Ton	27.00	51,300
10	Underlayer Stone 50-150#	23,700	Ton	27.00	6[illegible]
11	Underlayer Stone 3-30#	25,900	Ton	21.50	556,850
12	Concrete Walkway	250	L.F.	52.45	[illegible]3,11[illegible]
13	Filter Fabric	36,000	S.Y.	6.15	221,[illegible]
14	Topsoil	4,700	C.Y.	9.70	[illegible]
15	Seeding	9	Acre	1500.00	13,500
16	Mobilization & Demobilization		L.S.		1[illegible]8,000
	TOTAL CONTRACTORS EARNINGS				6,55[illegible]
	CONTINGENCIES @ 25%				1,638,7[illegible]
	CONTRACTORS EARNINGS PLUS CONTINGENCIES				8,190,000
	ENGINEERING & DESIGN				778,000
	SUPERVISION & ADMINISTRATION				852,000
	TOTAL FIRST COST OF CONSTRUCTION				$9,820,000
	ANNUAL MAINTENANCE COST				$170,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. APR 9/28/81

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Subject: Maumee Bay State Park Study

Computation of E & D - S&A & Maint. Costs - Alternative 3

Computed by AFR Checked by   Date

TOTAL CONTRACTORS EARNINGS PLUS CONTINGENCIES $8,190,000

Engineering & Design

8,190,000 @ 0.095 = 778,000

Superision & Administration

Supervision & Inspection

8,190,000 @ 0.065 = 533,000

Overhead

E&D: 778,000 @ .19 = 148,000

S&I: 533,000 @ .32 171,000

852,000

1,630,000

$9,820,000

Annual Maintenance Costs

Brkwtrs, etc - (8,190,000 - 1,6__,000) / 50 YRS = 125,500

Beach Nourishment - 5,000 @ 7.65 = 38,250

Monitor Beach Nourishment 6,000

Total - $169,750

Say $170,000

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Maumee Bay State Park Study (Trucked Sand On-Site Earth Fill)					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	ALTERNATIVE NO. 3b				
1.	Clearing and Grubbing	8	Acre	3,140.00	25,120
2.	Ditch Excavation	1,670	c.y.	5.00	8,350
3.	Stripping	23,300	c.y.	6.85	159,605
4.	Sand Beach Nourishment	260,000	TON	5.10	1,326,000
5.	Compacted Earth Fill	83,000	c.y.	2.25	186,750
6.	Armor Stone 1-3 Ton	31,100	TON	32.00	995,200
7.	Armor Stone 1200-2800 #	5,400	TON	37.50	202,500
8.	Armor Stone 700-1500 #	46,750	TON	37.50	1,753,125
9.	Underlayer Stone 80-280 #	1,900	TON	27.00	51,300
10.	Underlayer Stone 50-150 #	23,700	TON	27.00	639,900
11.	Underlayer Stone 3-30 #	25,900	TON	21.50	556,850
12.	Concrete Walkway	250	L.F.	52.45	13,113
13.	Filter Fabric	36,000	s.y.	6.15	221,400
14.	Topsoil	6,500	c.y.	9.70	63,050
15.	Seeding	12	Acre	1500.00	18,000
16.	Mobilization + Demobilization		L.S.		1[illegible]4,000
	TOTAL CONTRACTOR'S EARNINGS				6,344,[illegible]63
	CONTINGENCIES @ 25% ±				1,587,737
	TOTAL CONTRACTOR'S EARNINGS PLUS CONTINGENCIES				7,932,000
	ENGINEERING + DESIGN				753,000
	SUPERVISION + ADMINISTRATION				805,000
	TOTAL FIRST COST OF CONSTRUCTION				9,490,000
	ANNUAL MAINTENANCE COSTS				17[illegible],[illegible]

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. Repp/7 Oct 81 GPO : 1967 OF—[illegible]

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Subject Maumee Bay State Park Study (Trucked Sand + On-Site Earth Fill)
Computation of E&D, S&A and Maintenance Costs - Alternative 36
Computed by Repp ______ Checked by ______ Date 7 Oct 81

TOTAL CONTRACTOR'S EARNINGS PLUS CONTINGENCIES 7,932,000

Engineering & Design

7,930,000 (0.095) = 753,000

Supervision & Administration

S&I

7,930,000 (0.06325) = 501,600

Overhead

E&D 753,000 (0.19) = 143,100
S&I 501,600 (0.32) = 160,500

805,000

9,490,000

Annual Maintenance Costs

Breakwater 7,932,000 - 1,326,000 / 50 yrs = $126,100

Beach Nourishment 5000 @ 7.65 = 38,300

Monitor Beach Nourishment = 6,000

Total $170,400 Use $170,000

6.	Under layer Stone 50-150#
7.	Filter Cloth
8.	Mobilization + Demobilization
	TOTAL CONTRACTOR'S EARNING
	CONTINGENCIES @ 25% ±
	TOTAL CONTRACTOR'S EARNINGS
	ENGINEERING AND DESIGN
	SUPERVISION AND ADMINISTRA
	TOTAL FIRST COST OF CON

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Subject Maumee Bay State Park Study

Computation of E&D and S&A - Alternative # 5

Computed by Reeves Checked by ______ Date 10 Sept 81

TOTAL CONTRACTOR'S EARNINGS PLUS CONTINGENCIES			5,868,000
Engineering & Design			
5,863,000 (0.0975)			572,000
Supervision & Administration			
S&I	5,863,000 (0.07)	410,400	
Overhead			
E&D	572,000 (0.19)	108,700	
S&I	410,400 (0.32)	131,300	
			650,000
			7,090,000

Annual Maintenance Cost

Brkwtrs. etc

5,868,000 / 50 YRS = $117,000

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT: Maumee Bay State Park Study (Trucked Sand / On-Site Earth Fill)

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	ALTERNATIVE NO 3B				
1	Clearing and Grubbing	8	Acre	3,370.00	26,960
2	Ditch Excavation	1,670	c.y.	5.40	9,020
3	Stripping	23,300	c.y.	7.35	171,260
4.	Sand Beach Nourishment	260,000	TON	5.50	1,430,000
5.	Compacted Earth Fill	83,000	c.y.	2.40	199,200
6.	Armor Stone 1-3 Ton	31,100	TON	34.40	1,069,800
7	Armor Stone 1200-2800#	5,400	TON	40.30	217,620
8.	Armor Stone 700-1500#	46,750	TON	40.30	1,884,030
9.	Underlayer Stone 80-280#	1,900	TON	29.00	55,100
10.	Underlayer Stone 50-150#	23,700	TON	29.00	687,300
11.	Underlayer Stone 3-30#	25,900	TON	23.10	598,290
12.	Concrete Walkway	250	L.F.	56.30	14,0[illegible]
13.	Filter Fabric	36,000	s.y.	6.60	237,600
14.	Topsoil	6,500	c.y.	10.40	67,600
15.	Seeding	12	Acre	1610.00	19,320
16.	Mobilization & Demobilization		L.S.		133,000
17	Aids to Navigation		LS		80,550
	TOTAL CONTRACTOR'S EARNINGS				6,900,750
	CONTINGENCIES @ 25% =				1,725,250
	TOTAL CONTRACTOR'S EARNINGS PLUS CONTIN				8,626,000
	ENGINEERING & DESIGN				819,000
	SUPERVISION & ADMINISTRATION				951,000
	TOTAL FIRST COST OF CONSTRUCTION				$10,396,000
	ANNUAL MAINTENANCE COSTS				$191,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

Repp/7 Oct 81
RM/14 July 82 for Price L. of 6/82

GPO : 1967 OF—[illegible]

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Subject Maumee Bay State Park (Trucked Sand + On-site earth fi[ll]
Computation of E & D, S & A and Maint. Costs - Alt. 3b
Computed by Repp - Revd. R.M. Checked by ______ Date 7 Oct. 81
Rev. 15 July 82

Total Contractors Earnings plus Contingencies = $8,626,000

Engineering & Design
8,626,000 (0.095) = 819,000

Supervision & Administration
S & I 8,626,000 (0.06325) = 546,000
Overhead
E & D 819,000 (0.232) = 190,000
S & I 546,000 (0.393) 215,000 951,000
Project Cost w/o Lands = $10,396,000

Annual Maintenance Costs
Brkwaters.
8,626,000 - 1,430,000 / 50 yrs. = $144,000
Beach Nourishment
5000 cy @ 8.20 = 41,000
Monitor Beach Nourishment = 6,000
Total $191,000

APPENDIX D
DESIGN AND COASTAL PROCESSES

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

APPENDIX D

COASTAL DESIGN

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APPENDIX D

DESIGN ANALYSIS

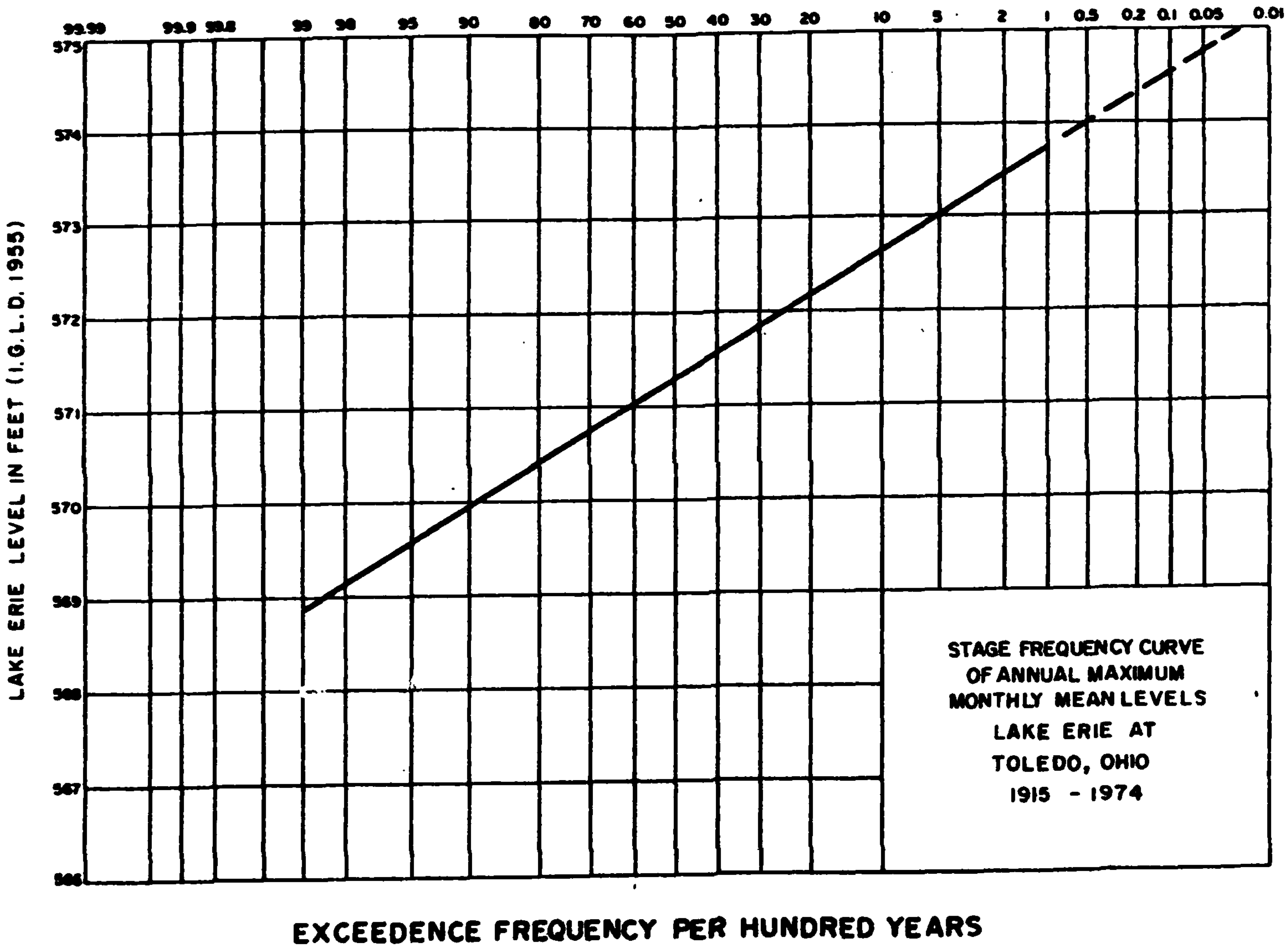
D1. INTRODUCTION

This appendix presents the design formulation, detailed design, and coastal processes for the protective beach with revetment alternative (Alternative 2a), the protective beach with revetment and offshore breakwaters alternative (Alternatives 3a and 3b), and the protective revetment base condition (Alternative 5) for the beach erosion control project for Maumee Bay State Park, Ohio. The main features of the protective beach with revetment alternative consist of a 5,500-foot long protective sand beach with a storm dune over the western half of the park, a 450-foot long rubblemound jetty at the western end of the beach along McHenry Ditch, a 250-foot long jetty at the eastern end of the beach along Berger Ditch, and a 6,200-foot long revetment along the eastern half of the park. The main features of the protective beach with revetment and offshore breakwaters alternative consists of a 5,500-foot long protective sand beach with a storm dune over the western end of the beach, a 250-foot long rubblemound jetty at the western end of the beach, a 250-foot long jetty along the eastern end, and a 6,200-foot long revetment along the eastern half of the park. In addition, eight offshore breakwaters are located parallel to the protective beach and approximately 600 feet offshore. The revetment along the eastern half of the park is identical to that in the first alternative, however, the protective sand beach is of smaller scale due to the protection provided by the offshore breakwaters. Two options for the smaller scale protective beach are presented which will be denoted as Alternatives 3a and 3b. Alternative 5 is a base condition alternative that does not have a protective beach or jetties but provides for shore protection only. This alternative primarily consists of a 5,500-foot long high revetment along the western half of the park and a 6,200-foot long low revetment along the eastern half of the park similar to Alternatives 2 and 3. The structural design of the features of these alternatives is found in Section D3 - Detailed Design.

D2. DESIGN FORMULATION

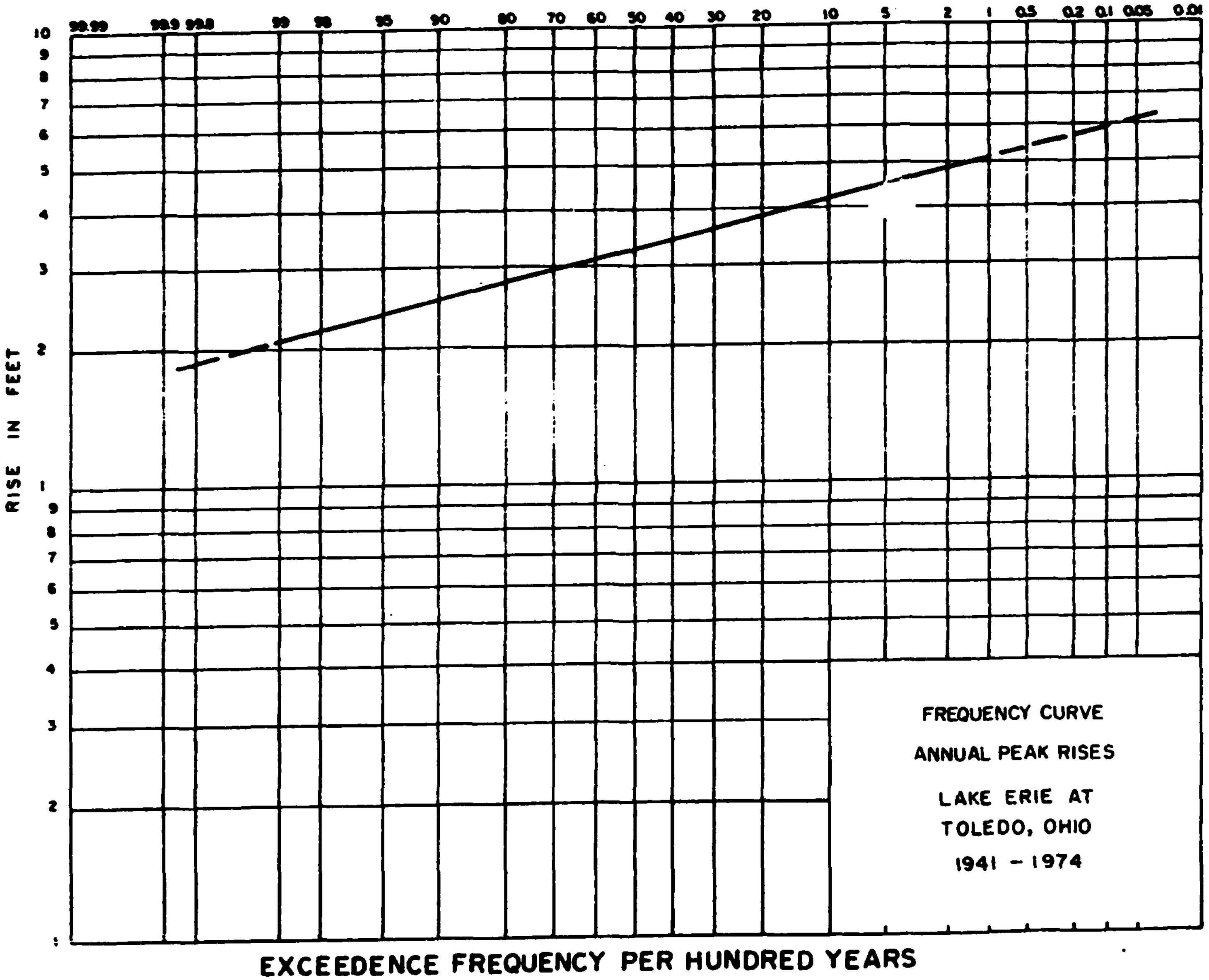
a. Design Water Level.

The design water level is a combination of the joint occurrence of long-term average lake levels with a short-term peak rise due to setup. Frequency curves for the long-term average levels and for the peak rises are shown in Figures D-1 and D-2 and are taken from the report "Standardized Frequency Curves for Design Water Level Determination on the Great Lakes," May and December 1979 (Ref. 14). The probability of a maximum lake level which will produce the largest wave conditions is obtained by summing the probabilities of all such combinations of long-term average lake levels and peak rises. This procedure is described in the Stage 2 PFR prepared by Moffat and Nichol Engineers (Ref. 15) and the resulting curve is presented in this report. Figure D-3 shows this curve for all frequencies of occurrence. In the design of this project, a 10-year or a 20-year design water level will be used in combination with a 10-year or 20-year design wave to arrive at a



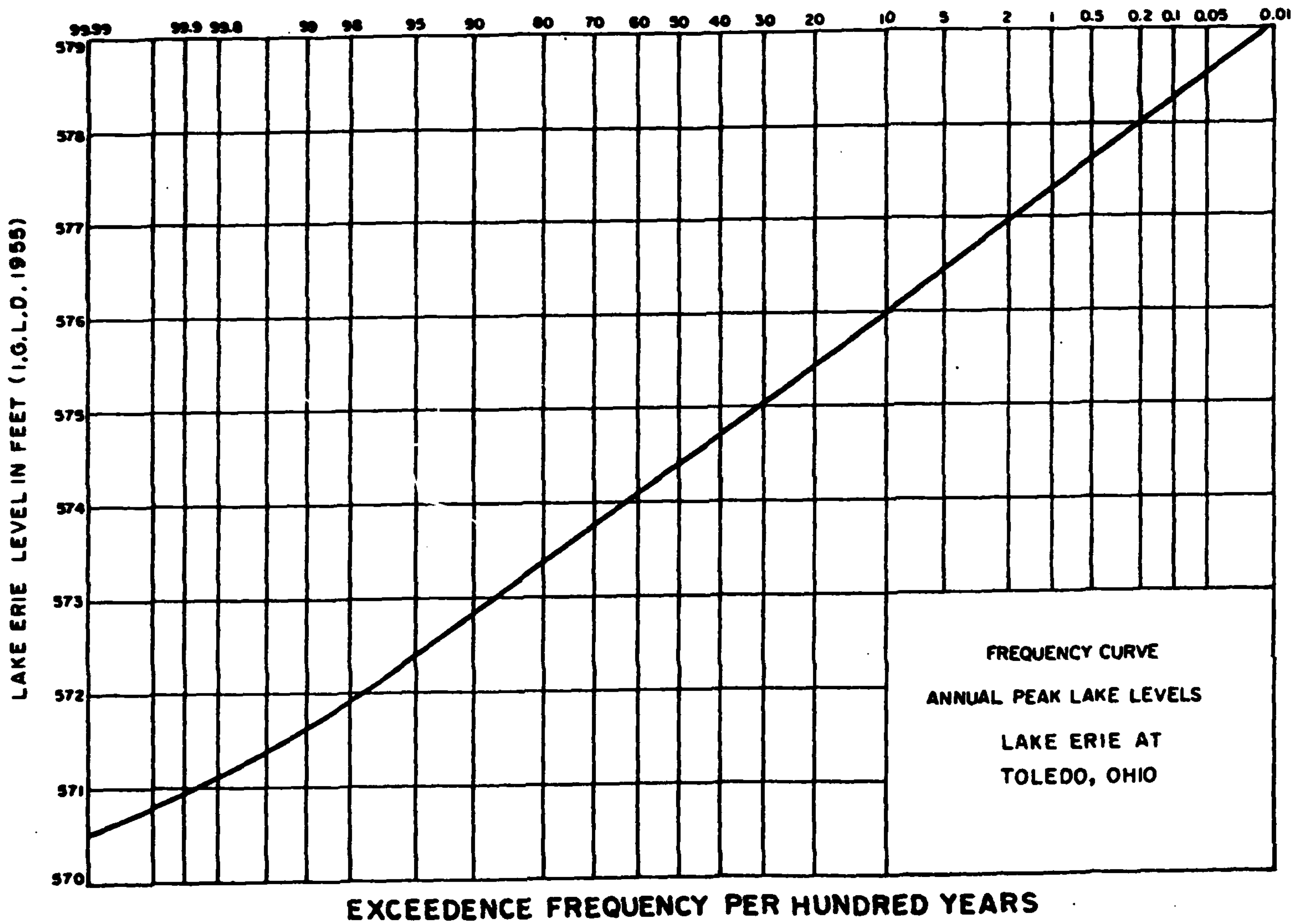
SOURCE: STANDARDIZED FREQUENCY CURVES FOR DESIGN WATER LEVEL DETERMINATION ON THE GREAT LAKES. MAY 1979.

Figure D-1



SOURCE: STANDARDIZED FREQUENCY CURVES FOR DESIGN WATER LEVEL DETERMINATION ON THE GREAT LAKES. MAY 1979.

Figure D-



SOURCE: STANDARDIZED FREQUENCY CURVES FOR DESIGN WATER LEVEL DETERMINATION ON THE GREAT LAKES, MAY 1979.

Figure D-3

combined 200-year event. This is usually done with a 10-year wave and a 20-year water level, or a 20-year wave and a 10-year water level, whichever event produces the largest design wave. Since this can't be determined until the wave analysis is performed, the 10- and 20-year levels are listed below, as taken from Figure D-3, and will be utilized in the wave analysis.

10-year design water level - 576.0 (IGLD)

20-year design water level - 576.5 (IGLD)

b. Design Waves.

(1) General - The west end of Lake Erie and Maumee Bay specifically are generally characteristic of an exceptionally flat and very shallow lake bottom. Maumee Bay has primarily a muddy bottom with its deepest part being only approximately 6 feet below LWD. The State Park can be subjected to waves from the northwest to the east, however, waves from the northwest are extremely limited by fetch and waves from the east through northeast are sheltered to various degrees by Little Cedar Point. Off of Little Cedar Point, a shoal exists that extends several thousand feet from shore, in a northwesterly direction and consists primarily of sand. Portions of this shoal are in very shallow water and are often exposed, which in turn has considerable influence on waves approaching from the north-northeast through east-northeast. The waves from these directions are usually the largest because of the large fetches and resulting setup. Due to the presence of this complicated offshore area, its significance in terms of wave refraction, diffraction, and breaking must be determined for the critical wave directions. These wave properties will be analyzed in the following sections.

(2) Deep Water Waves - The significant deep water wave heights and associated periods which could be expected at Maumee Bay, were determined by Waterways Experiment Station and published in Technical Report H-76-1, "Design Wave Information for the Great Lakes," Report 1, dated March 1976 (Ref. 16). Table D1 shows the significant deep water wave heights for the area off Maumee Bay, for three angle classes, and for each season of the year for various recurrence intervals. Table D2 lists the associated wave periods for the three angle classes. The angle classes are defined below as viewed by an observer standing on shore and are indicated in Figure D-4.

(a) Angle Class 1 - Mean wave approach angle greater than 30 degrees to the right of a normal to shore (east to northeast).

(b) Angle Class 2 - Mean wave approach angle within 30 degrees to either side of a normal to shore (northeast to north).

(c) Angle Class 3 - Mean wave approach angle greater than 30 degrees to the left of a normal to shore (north to northwest).

In order to determine what combination of wave height and lake level will produce the largest design wave, both the 10-year occurrence and 20-year occurrence wave heights for the most critical season will be input into the wave transformation program, which is discussed later in this section. This

AD-A138 420 MAUMEE BAY STATE PARK OHIO SHORELINE EROSION BEACH RESTORATION STUDY FINA..(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT DEC 83 2/6

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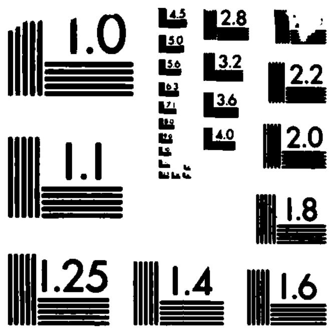


MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

TABLE OF EXTREMES ESTIMATES
GRID LOCATION 10, 2 LAT=41.72 LON=83.27 CEDAR POINT OH
SHORELINE GRID POINT 2

WINTER

	ANGLE CLASSES 1	2	3	ALL
5	4.9(0.6)	5.9(1.1)	3.9(0.5)	7.4(1.1)
10	6.6(0.8)	8.2(1.5)	5.2(0.6)	9.3(1.5)
20	8.2(1.0)	9.2(1.8)	6.6(0.8)	11.2(1.9)
50	10.2(1.2)	12.5(2.3)	7.9(1.0)	13.9(2.4)
100	11.5(1.4)	14.8(2.6)	11.2(1.1)	16.0(2.7)

SPRING

	ANGLE CLASSES 1	2	3	ALL
5	4.9(0.3)	6.2(0.6)	3.0(0.3)	7.7(0.6)
10	6.2(0.3)	8.2(0.8)	4.3(0.4)	9.2(0.8)
20	7.5(0.4)	9.8(1.0)	4.9(0.6)	10.7(1.0)
50	7.9(0.5)	10.8(1.2)	6.6(0.7)	12.7(1.3)
100	9.8(0.6)	13.4(1.4)	10.2(0.8)	14.4(1.5)

SUMMER

	ANGLE CLASSES 1	2	3	ALL
5	3.9(0.2)	4.9(0.3)	2.3(0.3)	4.4(0.3)
10	4.3(0.3)	5.2(0.3)	2.6(0.4)	5.4(0.4)
20	4.9(0.4)	5.6(0.4)	3.0(0.5)	6.4(0.5)
50	5.6(0.5)	6.9(0.5)	4.6(0.6)	7.8(0.6)
100	6.6(0.5)	8.5(0.6)	5.2(0.7)	8.9(0.7)

FALL

	ANGLE CLASSES 1	2	3	ALL
5	5.6(0.4)	5.6(0.7)	4.3(0.4)	7.8(0.7)
10	7.9(0.5)	7.5(0.9)	5.2(0.5)	9.3(1.0)
20	8.5(0.6)	9.5(1.2)	5.9(0.7)	10.9(1.2)
50	10.5(0.7)	12.1(1.4)	8.5(0.8)	13.1(1.5)
100	11.5(0.9)	13.8(1.7)	9.8(0.9)	14.8(1.7)

Table D-1

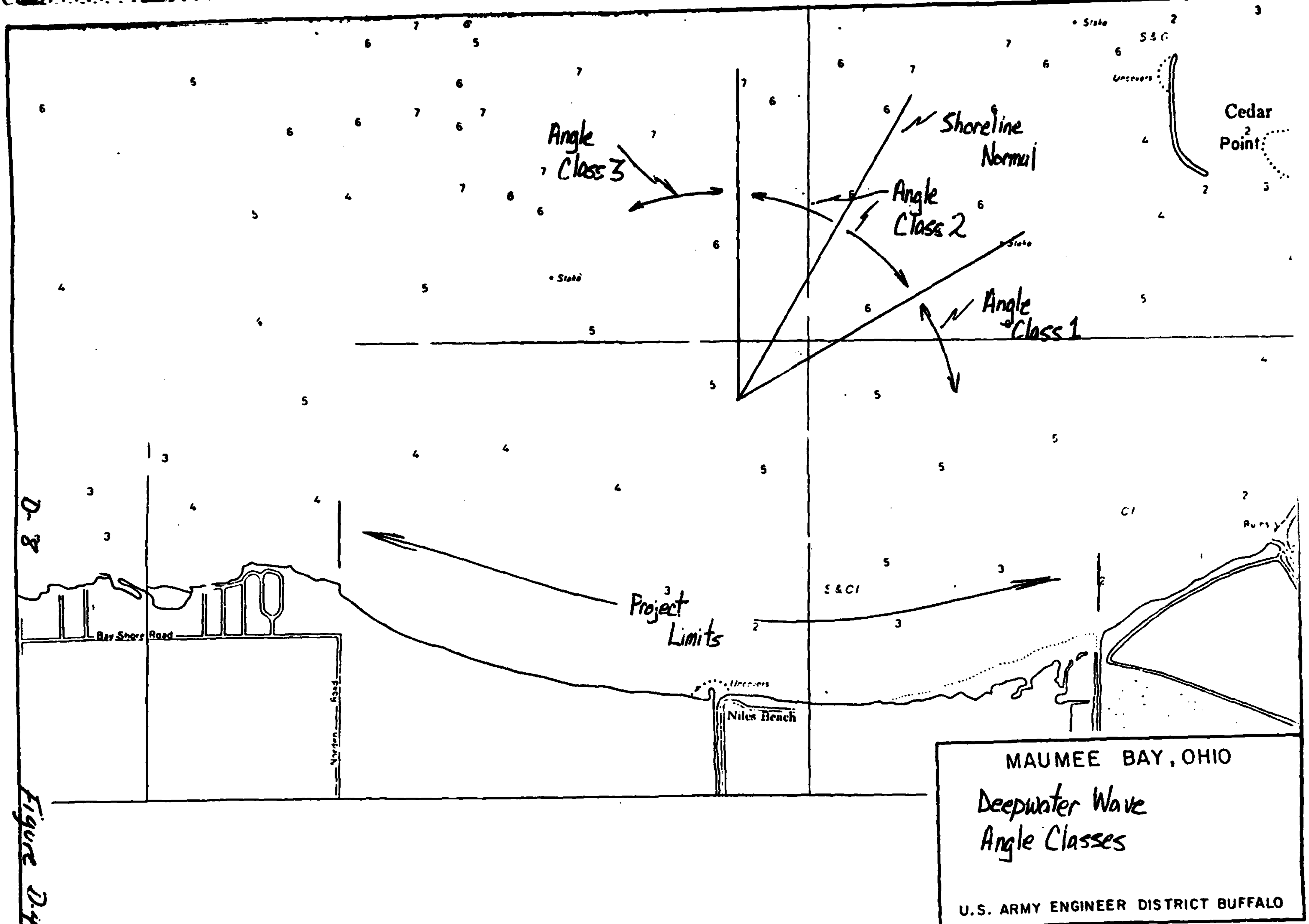
GRID LOCATION 10, 2 LAT=41.72 LON=83.27 CEDAR POINT OH

GRID POINT NUMBER 2

SIGNIFICANT PERIOD BY ANGLE CLASS AND WAVE HEIGHT

WAVE HEIGHT (FT)	ANGLE CLASS 1	2	3
1	2.5	2.5	2.3
2	3.6	3.7	3.3
3	4.7	4.8	4.0
4	5.4	5.5	4.4
5	5.7	5.8	4.7
6	6.0	6.1	4.9
7	6.3	6.4	5.2
8	6.6	6.8	5.4
9	6.9	7.1	5.6
10	7.2	7.4	5.9
11	7.4	7.7	6.1
12	7.7	8.0	6.3
13	8.0	8.4	6.5
14	8.3	8.7	6.8
15	8.6	9.0	7.0
16	8.9	9.3	7.2
17	9.2	9.6	7.5
18	9.5	10.0	7.7
19	9.8	10.3	7.9
20	10.1	10.6	8.1
21	10.3	10.9	8.4
22	10.6	11.2	8.6
23	10.9	11.6	8.8
24	11.2	11.9	9.1
25	11.5	12.2	9.3

Table D-2



MAUMEE BAY, OHIO

Deepwater Wave Angle Classes

U.S. ARMY ENGINEER DISTRICT BUFFALO

FIGURE

Figure D.4

results in a combination of two deep water wave heights and water levels for each angle class, for a total of six deep water wave/water level conditions.

(3) Wave Refraction Analysis - A refraction analysis was performed in order to help analyze the propagation of design deep water waves over the shoal area, the surrounding areas, and into the area of the park project. It was necessary to do a hand analysis (SPM Technique) (Ref. 17) opposed to using any computer-based refraction models, due to the complicated bathymetry, and the inherent unreliability of refraction models in areas of highly variable bathymetry. Refraction diagrams were constructed for four assumed deep water wave directions; North 30 degrees west, angle class 3, T = 6.8 seconds; North, angle class 3, T = 7.3 seconds; North 30 degrees east, angle class 2, T = 7.3 seconds; and, North 30 degrees east, angle class 1, T = 5.1 seconds (see Figures D-5 through D-8). For reasons of simplification and due to the limited reliability in this type of analysis, wave orthogonals were started just lakeward of Maumee Bay. This area is not true deep water, as required for an accurate analysis, however, the bottom contours are reasonably parallel to the assumed deep water wave crests. The wave orthogonals in each of Figures D-5 through D-8, with the exception of Figure D-7 shows fairly regular refraction patterns. The wave orthogonals in Figure D-7 are somewhat questionable due to the high rate of orthogonal convergence (caustic formation) and must be interpreted very subjectively. The manner by which these orthogonals converge and how to interpret their applicability was studied by R. W. Whalin (Ref. 18). His analysis shows that linear wave refraction theory, which is the basis for this refraction analysis is invalid in areas of high convergence. The principles of conservation of energy between orthogonals does not apply due to nonlinear effects including diffraction of wave energy along the wave crests. In the extreme case of a caustic, his data showed that from 22 to 85 percent of the wave energy is transmitted across the caustic boundary into higher frequency components. This phenomenon became more significant for longer and steeper waves. With the exception of Figure D-7 linear wave refraction theory was assumed valid. An average refraction coefficient was determined for each wave direction and for both the east and west halves of the park whose areas are separated by Berger Ditch.

Refraction coefficients were determined by measuring the relative spacing of orthogonals and incorporating these values into the equation $Kr = {}^{bo}/_{b}$ (SPM p. 2-69.

K_r = refraction coefficient
b_o = relative spacing of deep water orthogonals
b = relative spacing of orthogonals at the point of interest

For Figure D-7 (wave direction from N30°E), this equation could not be used due to the nonlineartles described above. In this case, the best that can be said is that there is a concentration of wave energy in the areas of orthogonal convergence. Based on the linear wave refraction theory results, and on the experimental results found by Whalin, a refraction coefficient limit for any set of ortogonals was set at 1.5. Refraction coefficients for the various wave directions for both the west and east portions of the park are listed in Table D3.

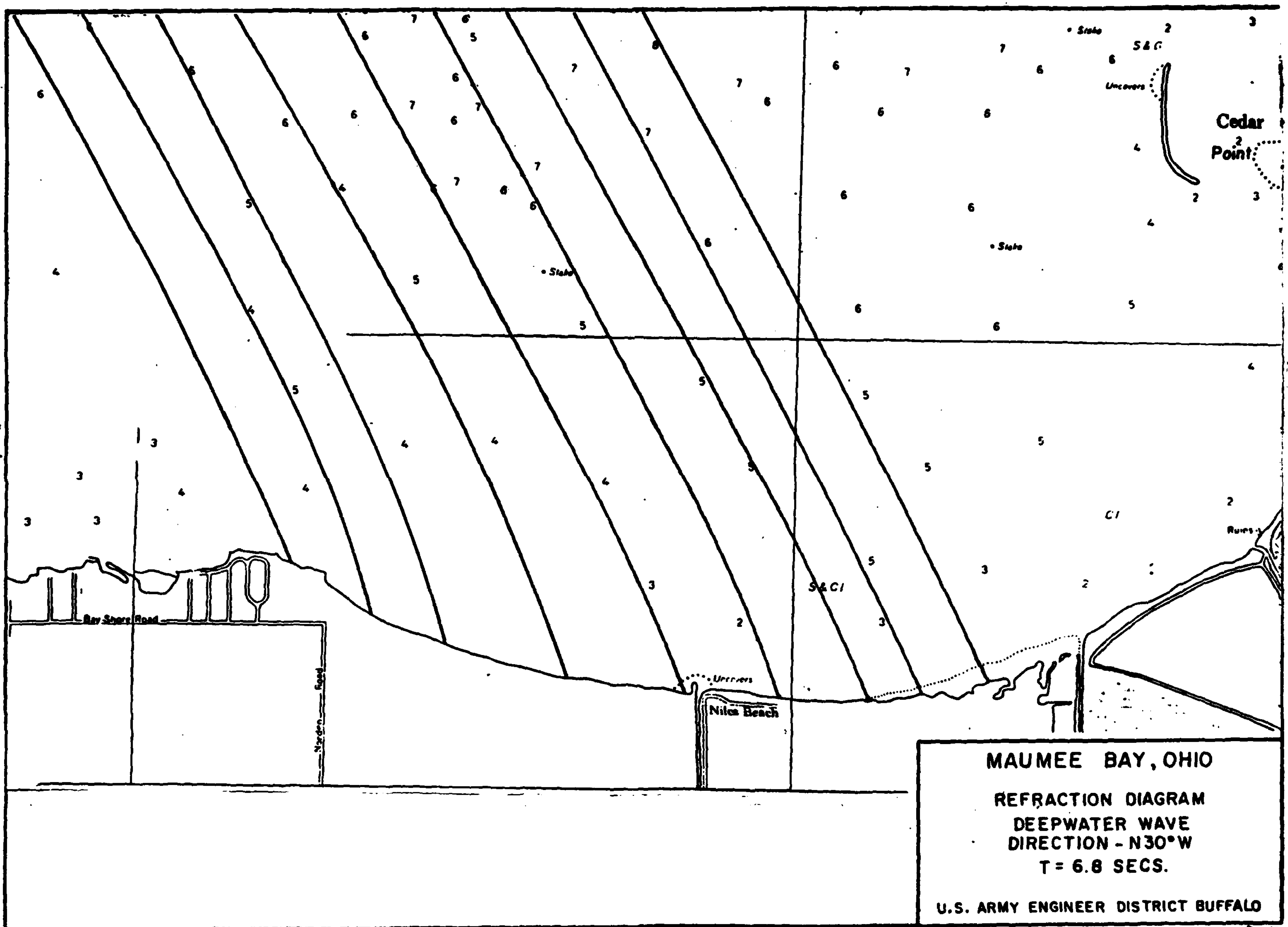
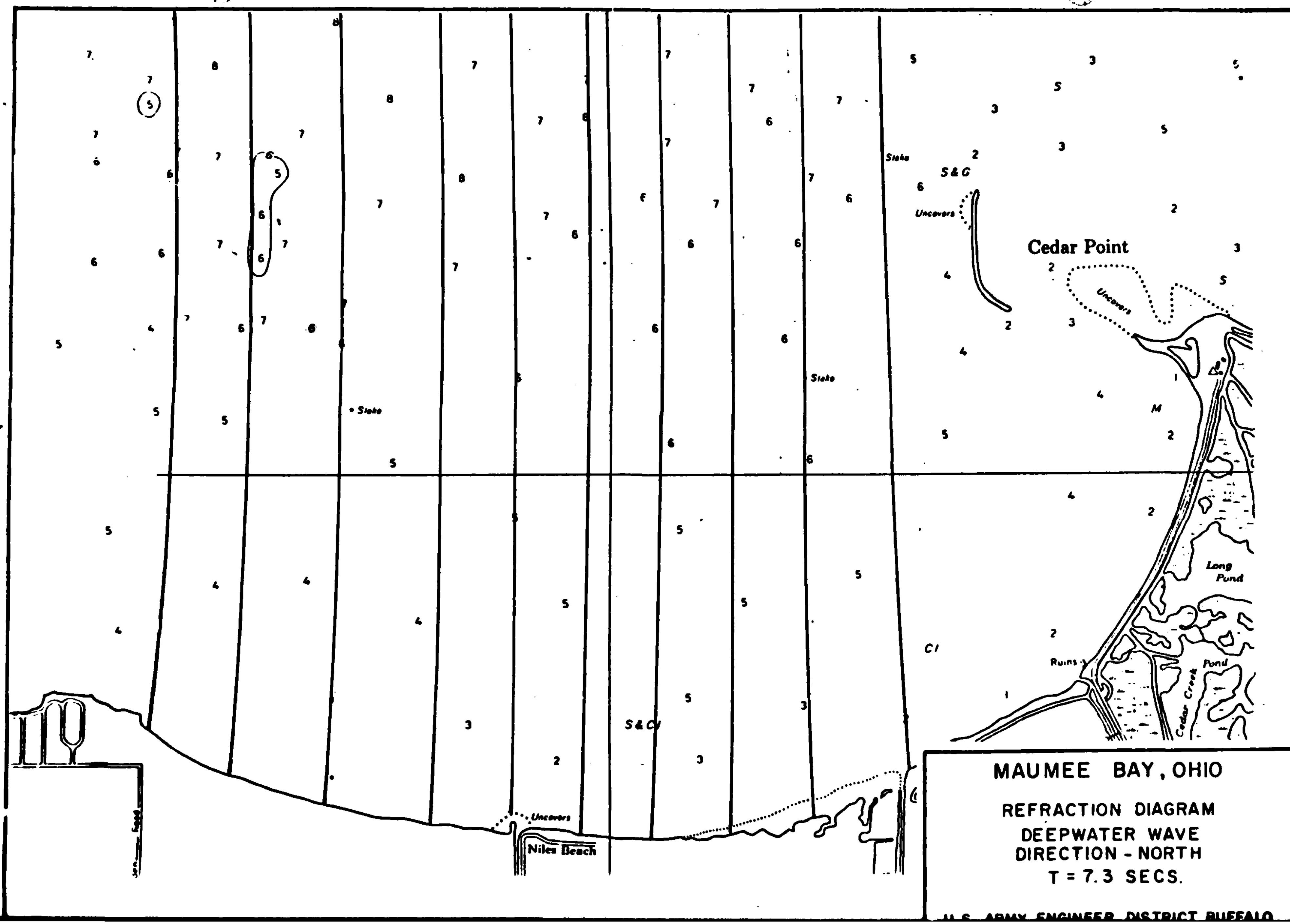

Cedar
Point
S&G
Uncovers
Stake
Ruins
S&CI
CI
Uncovers
Niles Beach
Bay Shore Road
Norden Road
MAUMEE BAY, OHIO
REFRACTION DIAGRAM
DEEPWATER WAVE
DIRECTION - N30°W
T = 6.8 SECS.
U.S. ARMY ENGINEER DISTRICT BUFFALO

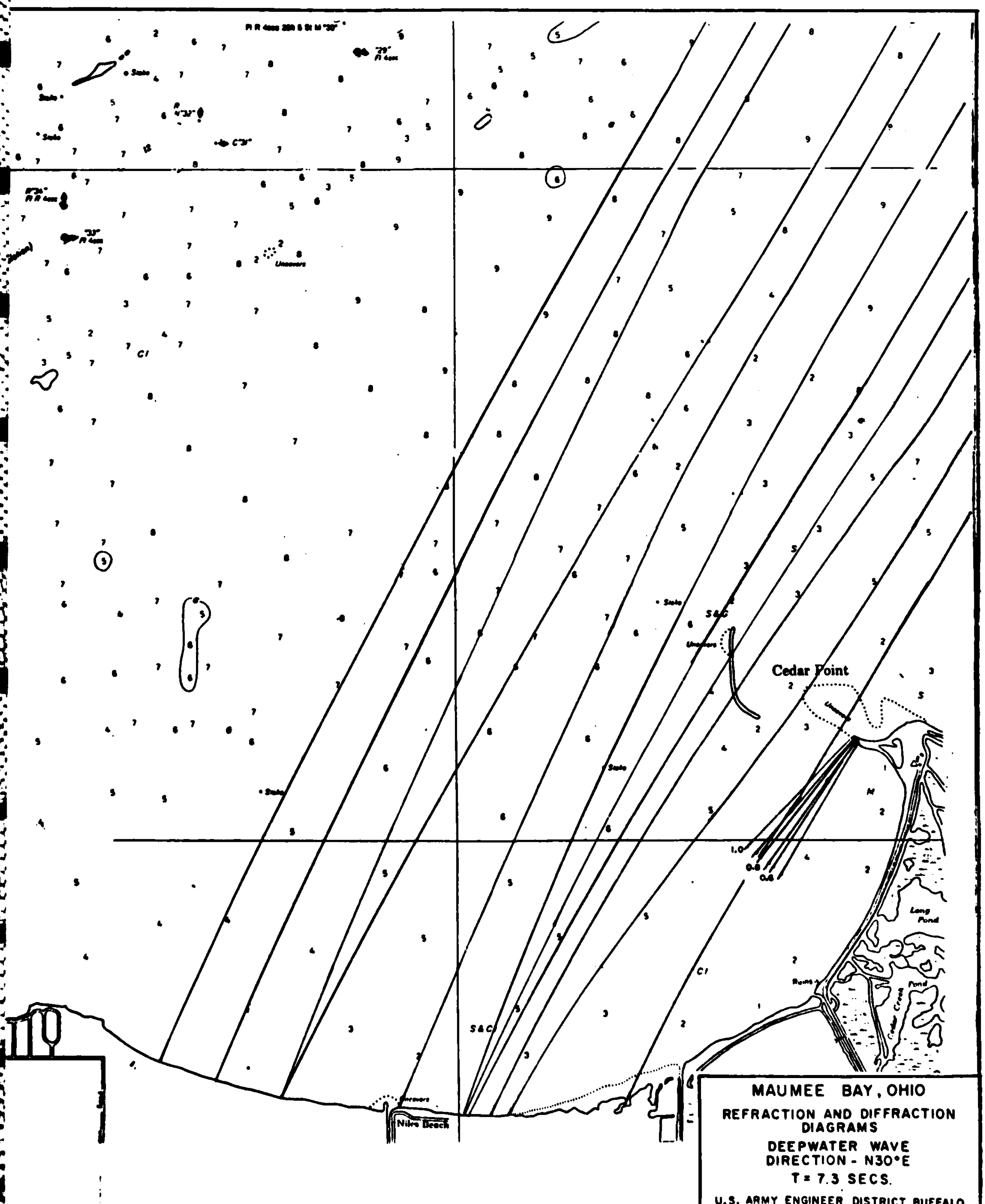
FIGURE D-5



MAUMEE BAY, OHIO

REFRACTION DIAGRAM
DEEPWATER WAVE
DIRECTION - NORTH
T = 7.3 SECS.

U.S. ARMY ENGINEER DISTRICT BUFFALO



MAUMEE BAY, OHIO

REFRACTION AND DIFFRACTION DIAGRAMS

DEEPWATER WAVE DIRECTION - N30°E

T = 7.3 SECS.

U.S. ARMY ENGINEER DISTRICT BUFFALO

FIGURE D-7

of input data, the program greatly reduces the manual work required to give the maximum design wave for the specified park location and depth. For matters of simplification and due to the preliminary stage of study, a single design wave is determined for the wildlife revetment and Berger Ditch revetment stability designs (east shore), a single design wave for the offshore breakwater stability designs (west shore) and a single design wave for the jetty and west shore revetment stability designs (west shore). A description of the location and purpose of these project features is found in Section D3 - Detailed Design.

Table D5 lists the various combinations of waves and water levels and other input data for the Goda 2 Program. The toe elevation for the offshore breakwaters was assumed to be at -3-foot LWD and the toe elevation for the nearshore structures was set at LWD. This results in design depths ranging from 7.4 to 10.9 feet for the various structures, depending on the final design water level.

The significant wave height (H_{sig}) was chosen for the design wave condition opposed to H_{max} due to the relatively mild wave conditions that are prevalent in the Maumee Bay area. H_{sig} is listed in the last column of Table D5 for all wave conditions tested, and is adjusted for any wave diffraction. Inspection of Table D5 shows the largest wave for the wildlife and Berger Ditch revetments is an Angle Class 2 wave equal to 4.8 feet; the largest wave for the offshore breakwaters is an Angle Class 2 wave equal to 6.5 feet; and the largest wave for the jetties and west shore revetment is also an Angle Class 2 wave equal to 5.0 feet.

(6) Breaking Conditions - Since it is not known whether the design waves calculated above are breaking waves an analysis is performed to determine the wave type. Consideration was first given to the impact of the shoal off of Little Cedar Point on whether it could cause premature wave breaking. However, since the shoal is also at or near LWD, the design wave should not be significantly affected by it. Additionally, the size of the shallow portion of the shoal is relatively small such that waves can regroup around it and continue towards shore without execessive disturbance. Using Figures 7-2 and 7-3 of the SPM, the following table is developed to determine the maximum and minumum breaking depths. If the design depth (d_s) falls within or less than this range, the wave will be considered a breaking wave. Table D6 shows that the wave-type for all of the project structures is a breaking wave.

c. Design Criteria and Assumptions.

The offshore breakwaters, jetties and revetments are designed in this report as rubblemound structures. A rubblemound design is used because of its high wave energy absorbing characteristics which is advantageous to a good functional structure. Structure cross sections were developed based on design criteria found in the SPM. The specific weight of the stone used in the design is 155 pounds per cubic foot, which is representative of stone found in that area.

The breakwaters, revetments, and jetties will be built on a bottom that varies from mud to silty clay. Little additional information is known about

Table D5 - Significant Wave Heights by Angle Class for Structure Design

Angle Class	Structure and Shore Reach	Ho 10 yr	Ho 20 yr	Lake Level 10 yr	Lake Level 20 yr	d	T	K_r	H_o'	L_o	H_o'/L_o	S	K_D	H_{sig}
		ft.	ft.	ft.	ft.	ft.	secs.		ft.	ft.		ft.		
1	Wildlife Revetment and Berger Ditch Revetment (East Shore)	7.9	-	-	576.5	7.9	6.6	1.0	7.9	223	.035	.01	0.25	1.3
		-	8.5	576.0	-	7.4	6.8	1.0	8.5	237	.036	.01	0.25	1.2
	Offshore Breakwaters (West Shore)	7.9	-	-	576.5	10.9	6.6	1.06	8.4	223	.038	.01	0.70	4.5
		-	8.5	576.0	-	10.4	6.8	1.06	9.0	237	.038	.01	0.70	4.4
	Jetties and West Shore Revetment (West Shore)	7.9	-	-	576.5	7.9	6.6	1.06	8.4	223	.038	.01	0.70	3.5
		-	8.5	576.0	-	7.4	6.8	1.06	9.0	237	.038	.01	0.70	3.3
2	Wildlife Revetment and Berger Ditch Revetment (East Shore)	8.2	-	-	576.5	7.9	6.9	1.24	10.2	244	.042	.01	0.95	4.8
		-	9.8	576.0	-	7.4	7.3	1.24	12.1	273	.044	.01	0.95	4.7
	Offshore Breakwaters (West Shore)	8.2	-	-	576.5	10.9	6.9	0.97	8.0	244	.033	.01	-	6.5
		-	9.8	576.0	-	10.4	7.3	0.97	9.5	273	.035	.01	-	6.3
	Jetties and West Shore Revetment (West Shore)	8.2	-	-	576.5	7.9	6.9	0.97	8.0	244	.033	.01	-	5.0
		-	9.8	576.0	-	7.4	7.3	0.97	9.5	273	.035	.01	-	4.9
3	Wildlife Revetment and Berger Ditch Revetment (East Shore)	5.2	-	-	576.5	7.9	4.8	0.99	5.1	118	.043	.01	-	4.3
		-	6.6	576.0	-	7.4	5.1	0.99	6.5	133	.049	.01	-	4.3
	Offshore Breakwaters (West Shore)	5.2	-	-	576.5	10.9	4.8	0.92	4.8	118	.041	.01	-	4.5
		-	6.6	576.0	-	10.4	5.1	0.92	6.1	133	.046	.01	-	5.3
	Jetties and West Shore Revetment (West Shore)	5.2	-	-	576.5	7.9	4.8	0.92	4.8	118	.041	.01	-	4.2
		-	6.6	576.0	-	7.4	5.1	0.92	6.1	133	.046	.01	-	4.3

Table D6 - Determination of Breaking Condition

Design Wave Location	H_o'	H_o'/gT^2	s	H_o/H_o'	H_b	H_b/gT^2	d_b/H_b MIN	d_b/Hb_2 MAX	d_b MIN	d_b MAX	d_s	Wave Type
	ft.		slope		ft.				ft.	ft.	ft.	
Offshore Breakwaters	8.0	.0052	.01	1.08	8.7	.0057	1.22	1.53	10.6	13.3	10.9	breaking
Wildlife Revetment and Berger Ditch Revetment	10.2	.0066	.01	1.03	1.05	.0068	1.23	1.54	12.9	16.2	7.9	breaking
Jetties and West Shore Revetment	8.0	.0052	.01	1.08	8.7	.0057	1.22	1.53	10.6	13.3	7.9	breaking

the subsurface composition, therefore, the use of filter cloth is included in all of the nearshore structure designs. The offshore breakwaters, however, will be built directly on top of a bedding layer. This is possible because of the more suitable bottom material at the depth of water where the structures are to be placed. A thorough subsurface exploration program will be performed during later stages of the project to aid in the final design.

The surveys used in determining placement and orientation of the structures were performed in July of 1979. Cross sections were taken at 1,000 foot intervals with a baseline established along Cedar Point Road. Soundings started in the nearshore area and were taken at 20-foot intervals to a lakeward distance of 600 to 800 feet with periodic soundings 3.5 miles into the lake. The surveys show an extremely flat offshore slope with water depths averaging only 4 to 5 feet below LWD at 1,000 feet offshore. Updated and more detailed surveys will be performed to better define existing conditions during later stages of the study.

D3. DETAILED DESIGN

a. <u>General</u>.

The Stage 2 Report recommended two action alternatives to be carried forward and further refined in Stage 3 of the study. Those that were determined to provide the most practical and economical solution were the protective beach with revetment plan (Alternative 2a) and the segmented offshore breakwater with protective beach and revetment plan (Alternative 3a and 3b). The main difference between the alternatives is that one incorporates offshore breakwaters with a relatively small protective beach while the other incorporates a large protective beach with no offshore protection. Additionally, as stated in the Conclusion Section of the Stage 2 report, it was determined that a "shore protection only" base condition alternative be investigated to be used for cost comparison purposes. This alternative is carried forward as Alternative 5 and is similar to Alternative 2a, except a revetment is substituted for the recreational beach and the need for jetties is omitted.

The groin alternative was deleted in Stage 2 from further study primarily because of the lack of a strong littoral drift which is mandatory for a groin system to be functional. The protective beach with revetment plan (Alternative 2a) retains the same protective beach design as that in the Stage 2 Report, however, several changes have been made to the jetty and wildlife revetment designs and layouts. Plate 1 is a plan view of Alternative 2a with modifications showing the layout of the protective beach, jetties and wildlife revetment. The beach extends between McHenry and Berger ditches for a total length of approximately 5,500 feet. It is terminated on each end by jetties whose purpose is to retain the sand beach and prevent sand from moving in and clogging the ditches. The western jetty will be 450 feet long and the existing eastern jetty will be rehabilitated to a length of approximately 250 feet. The existing protrusion of land just west of Berger Ditch will be reveted to protect this land and to avoid shoreward lengthening of the east jetty. The wildlife revetment extends from Berger Ditch to the National Wildlife Refuge property encompassing total lake frontage of

approximately 5,500 feet with total linear footage of approximately 6,200 feet. The additional 700 feet consists of the revetment "returns" that extend up the drainage ditches and also an overlapping portion at the gap. An opening is left at the east end of the revetment for Sauter Ditch to empty and a gap is provided midway along the revetment to provide circulation with the wildlife area. Plates D-2, D-3, D-4 and D-5 show cross sections of the protective beach, jetties and wildlife revetment including the short revetment just west of Berger Ditch (Berger Ditch Revetment).

Plate D-6 is a plan view of Alternative 3a and 3b with modifications to the Stage 2 plan layout of the offshore breakwaters, protective beach, jetties, and wildlife revetment. Eight offshore breakwaters 300 feet long and 300 feet apart are located approximately 700 feet from the existing shoreline. A typical cross section is shown in Plate D-7. Two options for the recreational beach (Alternatives a and b) that are to be protected by the offshore breakwaters are shown with cross sections for each option in Plates D-8 and D-9. The jetty plan will be the same as for Alternative 2a (Plate D-3), except the western jetty will be approximately 250 feet long. The wildlife revetment also remains identical to that in Alternative 2a (Plate D-4).

Plate D-10 is a plan view of Alternative 4 showing the layout of the west beach revetment, the wildlife revetment, and other shoreline features. A rubblemound revetment is constructed in lieu of the protective beach and is designed to provide only protection to the eroding beach. A cross section of the west shore revetment is shown in Plate D-11. The wildlife revetment is identical to Alternative 3a and 3b (Plate D-4), however, the need for jetties has been deleted since they would have no shore protection related usefulness.

b. <u>Alternative 2a - Protective Beach, Revetment</u>.

The protective beach with revetment alternative as described in the Stage 2 Report consisted basically of a 5,500-foot long protective beach along the western shore of Maumee Bay and a 6,200-foot long revetment along the eastern shore or wildlife area. The protective sand beach extends from McHenry to Berger Ditch and is intended to absorb and dissipate incoming wave energy, protect the existing beach and scarp, and provide for a recreational beach. The revetment along the wildlife area is intended to retard further erosion of the shore and is designed to allow circulation of water into and out of the area through openings in the revetment and by wave overtopping.

The protective sand beach remains essentially the same as that designed in the Stage 2 Report, however, some modifications have been made to the jetty designs on the east and west ends of the beach. The wildlife revetment has been substantially redesigned and includes protection to approximately 5,500 feet of lake frontage. The jetty at the west end of the revetment has been deleted and a new layout and cross section for the revetment has been developed.

Additionally, instead of placing sand lakeward of the small parcel of protruding land just west of Berger Ditch, which would thereby destroy the continuity of the beach or allow this land to erode back to the protective

beach, a revetment will be constructed in front of this land. The revetment will be similar to the wildlife revetment, except it will have a higher crest to limit the degree of overtopping. These calculations along with the design of the protective beach and wildlife revetment are presented in the following sections.

(1) Protective Beach

(a) Size and Configuration - The design of the protective beach that was presented in the Stage 2 report is shown in Plate D-2. The beach will average 250 feet in width at normal lake levels with a 60 feet berm at +8 feet, a 50-foot berm at +10 feet LWD and a 2-foot vegetated storm dune at +12 feet LWD. Based on SPM criteria for medium sand fill and observations of other similar projects, the foreshore slope is set at 1 vertical to 20 horizontal. The total volume of sand for the entire 5,500-foot reach is approximately 275,000 yds^3. It is necessary to build and maintain a beach of this size due to the anticipated beach fill losses, that will occur on a yearly basis as dictated by the present severe erosion rates. Even though the wave climate is mild during the majority of the time, periodic storms are quite severe and will result in substantial beach readjustment and realignment. All indications show that over a period of time sand will migrate both east and west, however, the larger buildup will be towards the west end of the beach. The backpassing quantities for a beach of this size are estimated at 25,000 yds^3/year. Besides backpassing, additional sand will be lost to offshore areas. An estimate of the annual nourishment rate for an unprotected beach of this size and location is 20,000 yds^3/year. More detailed information on nourishment rates and beach erosion processes are found in Section D4 - Coastal Processes.

The beach will extend from the jetty at McHenry Ditch and extend eastward to meet the existing land and revetment near Berger Ditch as shown in Plate D-1. The storm dune will extend along the shoreward edge of the beach and terminate upon intersection with the jetties at the ditches. At McHenry Ditch the dune will terminate upon meeting the jetty at the bank of the ditch, but at Berger Ditch the dune will extend along the ditch to intersect the shoreward terminus of the present jetty.

(b) Beach Berm Elevations - The beach berm elevations were set such that little or no overtopping would be allowed. Overtopping is not desirable since it would tend to increase sand losses by overwash and would increase offshore losses by pumping through the beach face. In accordance with Coastal Engineering Technical Aid No. 78-2, "Revised Wave Runup Curves for Smooth Slopes," (Ref. 12) the berm at +8 feet will prevent overtopping in a typical year and the berm at +10 feet will prevent overtopping during rare storm events. The vegetated storm dune extends another 2-foot to +12 feet to prevent sand overwash due to extremely rare storm events while the majority of the berm acts to retain the beach fill.

(2) Jetties

(a) Plan and Layout - The jetty design for the protective beach and revetment alternative as proposed in the Stage 2 report called for a 450-foot

jetty along the west end of the protective beach with two 250-foot jetties along Berger Ditch. The jetties at the ends of the beach are intended to retain the beach fill and keep it from moving into and clogging the ditches. The 250-foot jetty, on the east side of Berger Ditch is intended to keep westward moving littoral material along the wildlife area from entering and clogging Berger Ditch. The jetty design also called for a concrete diaphram 2 feet wide to prevent migration of sand through the jetties and into the ditches and also to be used as a walkway for fishermen.

Due to a revised wave analysis and a more thorough inspection of existing conditions and littoral processes, it was necessary to make several design modifications to the jetties. Plate D-1 shows the revised jetty locations and Plate D-3 shows a typical cross section. The westerly jetty along the protective beach remains 450 feet long and a rehabilitated jetty at the east end is 250 feet. The concrete diaphram has been replaced with a filter cloth that will lay between the armor stone and the underlayer stone (Plate D-3) and will restrict the movement of sand through the jetties. In addition, a concrete walkway 2.5-foot-wide by 2-foot-thick will be placed at the crest of the jetty to be used by fishermen. Due to the presence of an existing rubble jetty along the west side of Berger Ditch (east end of the Berger Ditch revetment), it is not necessary to construct a new jetty but rather rebuild the existing one. It presently extends sufficiently far in the lakeward direction but will require added armor stone to be structurally sound and attain the necessary crest elevation. The structure will intersect with the storm dune on its shoreward end along Berger Ditch. A cross section of the rehabilitated jetty cannot be presented until more detailed surveys are made. The jetty that was proposed for the east side of Berger Ditch has been totally deleted because its intended purpose of keeping westward moving littoral material out of Berger Ditch is not warranted. The ditch as it exists does not experience any clogging conditions due to the small amount of littoral material in its vicinity and due to the clearing action of the discharge water. Additionally, with the presence of the wildlife revetment the source of littoral material from the east will be substantially reduced thereby reducing chances for the ditch to clog.

The following computations on pages D-22 and D-23 contain the design of the stone sizes, layer thicknesses, and elevations for the rubblemound jetty to be located at the west end of the protective beach. The armor stone that is prescribed will also be used to build a protective layer over the existing rubblemound jetty on the west side of Berger Ditch. A typical cross section is shown in Plate D-3.

BY TJB DATE 1/7 SUBJECT Jetty Design - Stone sizes, Layer thicknesses - Maumee Bay State Park SHEET NO. ...... OF ......
CHKD. BY ...... DATE ...... JOB NO. ......

(b.) Armor Unit Weight

$$W = \frac{w_r(H^3)}{K_\Delta (S_r - 1)^3 \cot\theta}$$ ✓

Where $w_r = 155$ lbs/ft³
$H = 5.0$ ft
$K_\Delta = 2.9$ - structure head, breaking wave
$S_r = 2.48$
$\cot\theta = 1.5$

$$W = \frac{(155)(5.0)^3}{2.9(2.48-1)^3 1.5} = 1374 \text{ lbs}$$

Use 0.9W to 2.0 W

or 1237 lbs to 2748 lbs ⇒ Use 1200 lbs to 2800 lbs

(c.) Armor Layer Thickness

$$r = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

Where $n = 2$
$k_\Delta = 1.15$
$W = 1374$ lbs
$w_r = 155$ lbs/ft³

$$r = 2(1.15)\left(\frac{1374}{155}\right)^{1/3}$$

$r = 4.8$ ft. ⇒ Use $r = 5.0$ ft.

(d.) Crest Width

$$B = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

Where $n = 3$
$k_\Delta = 1.15$
$W = 1374$ lbs.
$w_r = 155$ lbs/ft³

$$B = 3(1.15)\left(\frac{1374}{155}\right)^{1/3}$$

$B = 7.2$ ft.

Use $B = 7.5$ ft.

BY I.J.K. DATE 7/1/81 SUBJECT Jetty Design - Underlayer, Crest Elevation, Filter Curtain, Walkway - Maumee Bay State Park SHEET NO. ...... OF ......
CHKD. BY ...... DATE ...... JOB NO. ......

(e) Underlayer (Bedding Stone)

Use 0.2W to 0.06W

$0.2W = 0.2(1374) = 275$ lbs.

$0.06W = 0.06(1374) = 82$ lbs

Use 80 lbs. to 280 lbs.

Underlayer stone will be used a bedding stone and will be placed directly on top of a filter cloth

(f) Crest Elevation

The purpose of the jetties is to retain the protective beach and to prevent the drainage ditches from clogging. Since the beach fill will be placed to elevation +10 LWD it is necessary to construct the jetties at least to this elevation. The jetties will therefore be constructed to elevation +10 ft LWD.

(g) Filter Curtain

A filter curtain (filter fabric) is to be placed as shown in Plate 3 to intercept the movement of sand through the jetties. The fabric will be placed during construction and will extend from the underlayer stone to the concrete walkway.

(h) Walkway

A concrete walkway 3 ft wide by 2 ft thick will extend the length of both jetties. The walkway will be built along the top center of the jetties and will be used for fishing areas.

(3) <u>Wildlife Revetment</u>

(a) Plan and Layout - The wildlife revetment proposed in the Stage 2 report consisted of 5,500 lineal feet of revetment extending eastward from Berger Ditch to meet the existing revetment at the Federal Wildlife Refuge. The revetment was segmented at Sauter Ditch and midway along the revetment in order to permit exchange of water and maintain the wetland environment. It was also designed having a low crest elevation (+8.0) to permit some overtopping and allow further circulation of waters.

Upon further review of the design wave height and the littoral processes, several design modifications have been made to the revetment. These include a revised cross section reflecting a smaller design wave height, a slight increase in the structures crest elevation, and considerable change in the revetment layout and positioning. Plate D-1 shows the revised positioning of the wildlife revetment and Plate D-4 shows the revised cross section. The revetment follows a more sinuous pattern which follows more closely the existing shoreline and terminates approximately 50 feet up Berger and Sauter Ditches. Approximately midway along this reach, the revetment will be segmented with a 100-foot opening and 100-foot overlap. The ends of the revetment at the opening will be widened to provide a turn-around area for service and maintenance vehicles. At the east end of the park boundary an additional segment of revetment will extend approximately 700 feet from Sauter Ditch to intersect with the existing Federal Wildlife revetment. The entire revetment will comprise a total length of approximately 6,200 lineal feet.

The cross section shown in Plate D-4 was changed from a 3-layer design to the present 2-layer design due to the reduction in the design wave height and hence the stone size necessary for structure stability. The armor stone will range from 700 to 1,500 pounds and will be placed on an underlayer stone from 50 pounds to 150 pounds. The crest elevation was set to allow a maximum 2.5-foot transmitted wave. This is thought to be the maximum wave that will not cause excessive damage in the lee of the revetment. These computations along with other design information for the revetment are found in Sections (b) through (f) on pages D-25-D-27.

The crest width only need be 5.9 feet wide for stability but is increased to 12 feet wide to provide an access and maintenance road on top of the structure. This would be done by extending the armor stone and underlayer stone in the shoreward direction by approximately 6.0 feet. A smaller grade stone in the range of 10 to 100 pounds would be placed on the crest to fill in the voids and make it a driveable surface. Since the roadbed will be occasionally overtopped, periodic maintenance will be required to replace lost and displaced road bed stone. The option of building the maintenance road on the landward side of structure thereby keeping the crest width at 5.9 feet was also considered, however, this design would lead to more complicated foundation problems and considerably higher construction costs.

BY .... DATE	SUBJECT Wildlife Revetment - Stone Size, Layer thicknesses	SHEET NO. .... OF........
CHKD. BY .... DATE		JOB NO. ....

(b) Armor Unit Weight

$$W = \frac{w_r (H)^3}{K_\Delta (S_r - 1)^3 \cot\theta}$$

Where $w_r = 155$ lbs/ft^3
$H = 4.8$ ft breaking
$K_\Delta = 3.5$
$S_r = 2.48$
$\cot\theta = 2.0$

$$W = \frac{(155)(4.8)^3}{(3.5)(2.48-1)^3(2.0)}$$

$W = 755$ lbs

Use 0.9W to 2.0W

or 680 lbs to 1510 lbs. ⇒ Use 700 lbs to 1500 lbs

(c) Armor Layer Thickness

$$r = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

Where $n = 2$
$k_\Delta = 1.15$
$W = 755$
$w_r = 155$

$$r = (2)(1.15)\left(\frac{755}{155}\right)^{1/3}$$

$r = 3.9$ ft ⇒ Use $r = 4.0$ ft.

(d.) Crest Width

$$B = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

Where $n = 3$
$k_\Delta = 1.15$
$W = 755$
$w_r = 155$

$$B = (3)(1.15)\left(\frac{755}{155}\right)^{1/3}$$

$B = 5.9$ ft

Use $B = 6.0$ ft.

(e) Underlayer (Bedding Stone)

Use: 0.2W to 0.06W

$0.2W = 0.2(755) = 151$ lbs

$0.06W = 0.06(755) = 45$ lbs

Use 50 lbs to 150 lbs

Underlayer Stone will be used as bedding stone and will be placed directly on top of a filter cloth. Armor stone will also extend 5 ft over the top of the underlayer to provide protection to underlayer against scour.

(f) Crest Elevation

$H_o' = 10.2$ $\quad H_i = 4.8$ ft. $\quad \cot\theta = 2.0$

$T = 6.9$ $\quad H_o'/gT^2 = .0066$

$L_o = 244$

$d_s = 7.9$ $\quad d_s/H_o' = 0.77$

From Fig 7-10 (SPM) for $d_s/H_o' = 0.8$ $\quad R/H_o' = 2.45$

$\therefore R_{SMOOTH} = (2.45)(10.2) = 25.0$ ft

From Fig 7-13 (SPM) $\quad k = 1.19$

$\therefore R_{SMOOTH_{ACTUAL}} = (25.0)(1.19) = 29.8$ ft.

From Fig 7-15 SPM $\quad R/H_o'{}_{RIPRAP} = 1.28$

Rough slope correction = $\frac{R/H_o'\ _{RIPRAP}}{R/H_o'\ _{SMOOTH}} = \frac{1.28}{2.45} = 0.52$

$\therefore R_{RIPRAP} = (0.52)(29.8) = 15.5$ ft.

Apply slope correction factor

$H_{SIG}/H_o'\ _{1on100} = 0.47$

$H_{SIG}/H_o'\ _{1on10} = 0.78$

$\frac{0.47}{0.78} = 0.60$

Actual Runup = $(15.5)(0.60) = 9.3$ ft.

Crest Elevation

Using Cross and Sollit Technique

$K_T = \frac{H_T}{H_I} = 0.54(1.04 - H_{bi}/R)$

H_T = Max 2.5 ft. transmitted wave.
H_I = 4.8
H_{bi} = crest height
R = wave runup = 9.3 ft.

$H_{bI} = R(1.04 - \frac{H_T}{.54 H_I})$

$H_{bI} = 9.3(1.04 - \frac{2.5}{.54(4.8)})$

$H_{bI} = 0.70$ ft.

Crest Height = $0.7 + 7.9 = +8.6$ ft. LWD = 577.2 ft

(4) Berger Ditch Revetment

(a) Plan and Layout - As described earlier, the purpose of the Berger Ditch revetment is to protect a small parcel of wooded land located at the east end of the protective beach and on the west side of Berger Ditch. The protrusion of land as shown on Plate D-1 exists because of some crude shore protection that was placed years ago to protect the land of which some of the protection still exists but is in poor condition. The revetment designed to protect this land is shown on Plate D-5 and consists of a 200-foot length parallel to shore and a 250-foot landward extension. The revetment is the same design as the wildlife revetment, except its crest elevation is slightly higher in order to limit the degree of overtopping. The crest elevation is set at +10 LWD which will coincide with the elevation of the jetties. The crest width will only be 6.0 feet since the crest will not be used as a service road. An armor stone apron will not be required on the landward side as will the wildlife revetment due to the limited degree of overtopping.

c. Alternative 3a and 3b - Offshore Breakwaters, Protective Beach, Revetment.

The Stage 2 report offshore breakwater alternative consisted of four offshore breakwaters, each being 600-foot long and 600 feet apart. The breakwaters were located 800-1000 feet offshore and placed at -3 feet LWD with crest elevations of +8 feet LWD. All other facets of this alternative including the protective beach and wildlife revetment remained the same as Alternative 2a, except for the west jetty that was reduced from 450 feet to 250 feet. During this study, considerable changes were made to the breakwater cross sections and layout (length and spacing) based on experience with the offshore breakwater systems at Presque Isle State Park, Lakeview Park, available research literature and design information on the subject and a revised wave analysis. Due to the protection provided by the breakwaters, it was also possible to reduce the size of the protective beach. Two new cross sections have been developed with a minimum width required to protect the existing shore and provide a 250-foot wide recreational area. One option (Alternative 3a) includes recessing the beach back 100 feet, thereby reducing beach fill quantities and material necessary for the storm dune. The other option (Alternative 3b) includes substituting beach area with a grassy area which would be placed behind the vegetated storm dune. The wildlife revetment and jetty plan have been redesigned and are the same as Alternative 2a, except the west jetty has been reduced to 250 feet in length.

Offshore breakwaters in principle function by reducing the wave energy that strikes a shoreline thereby creating a quiet zone where littoral material is either trapped or stabilized. As sand is deposited due to the dissipation of the wave energy and longshore transport, a shore salient is formed which in turn acts as a groin to cause the updrift shoreline to advance. Maumee Bay is somewhat peculiar in that sand moving along the shoreline is very scarce and there is a lack of any strong dominant littoral drift direction. This makes it necessary to design an offshore breakwater system to protect an artificial beachfill that essentially will not be fed by natural littoral processes. This involves many parameters of design including structure

length, spacing, distance offshore, crest elevation, and incident wave conditions. These parameters, along with the structural design are analyzed on pages D-29-D-40.

(1) Segmented Offshore Breakwaters

(a) Distance Offshore and Design Depth - The distance of an offshore breakwater system from the shoreline is dependent on several variables including breakwater length, spacing, wave conditions, bathemetry, and cost. In most cases it can be found that the distance offshore and hence the design depth are usually controlling factors as determined by the size and purpose of the project along with the cost and method of construction. The other parameters including breakwater length and spacing can then usually be tailored to this criteria in a cost effective manner based on wave conditions at the site.

Usually the farther from shore the deeper the water, and the cost of the structures will normally increase dramatically. Since Maumee Bay is extremely flat and shallow, the depth of the structures is not of paramount concern in regards to the offshore distance of placement. However, one important restriction at Maumee Bay is the minimum depth of placement. Since the most economical way to construct the breakwaters is with floating plant, a minimum of 6 feet of water is necessary to prevent tugs and barges from grounding. Based on recent lake levels, this would be at about -3 feet LWD and at a distance of approximately 600 feet from shore. Due to this relatively long distance from shore and the greater wave exposure encountered by extending out any further, the 600-foot distance and -3 feet LWD depth contour is selected for placement of the breakwaters. Being this far from shore, the breakwaters would be sufficiently far from the beach and beach salients, thereby eliminating an easy access by swimmers to the breakwaters. This distance also allows sufficient room for wave energy to spread out and dissipate in the lee of the structures thereby having less adverse impacts on the protective beach.

(b) Length and Spacing - A major concern with the present design is that too much wave energy could enter the 600-foot gaps which would result in a severely scalloped beach. The result of this would be large proturberances behind the breakwaters but with heavy erosion in the lee of the gaps. In order to cut down on the amount of beachfill necessary for protection and to provide a more regular beach profile, the new design calls for shorter breakwaters and smaller gaps between them even though the total breakwater length is not changed. Silvester (Ref. 11) in his paper "Offshore Breakwaters" researches characteristics of wave patterns in the lee of a breakwater and describes its paramount significance in the formation or nonformation of a tombolo. Preliminary calculations for Maumee Bay based on the results of his findings indicate that a series of shorter breakwater lengths and spacings would provide for a more regular beach formation, therefore, requiring a smaller artificial beach.

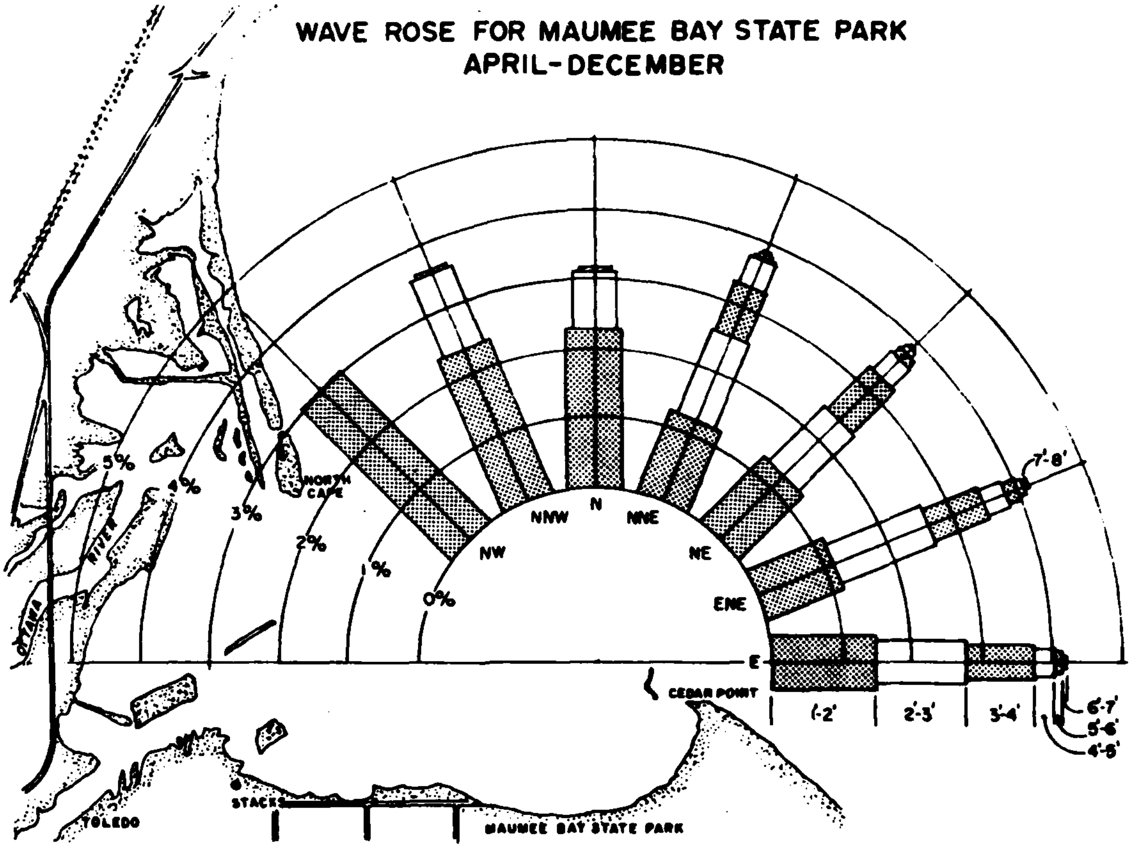
In an attempt to further optimize breakwater placement an analysis was performed similar to that performed by Moffat & Nichol Engineers for the Lakeview Park, Ohio, GDM (Ref. 13). The basis for their design lies in the

assumption that if the diffraction coefficient (K_D) isolines from the gross easterly and westerly wave directions intersect lakeward of the shoreline, enough wave energy is present to prevent the formation of a tombolo, yet maintain a relatively stable beach salient.

This analysis utilizes the hindcast wave data that was developed in the Stage 2 report, however, instead of computing gross wave directions, the data was converted to gross wave-energy directions. This was done by squaring the average wave heights for the various wave directions and frequencies and arriving at a weighted average for determining the gross easterly and westerly directions. The effects of diffraction and refraction were included to help determine the magnitude and direction of the waves at the site. It is believed this is more meaningful than wave direction alone because it is necessary to determine which wave directions are responsible for the transport of littoral material at the structure location (i.e., which wave directions contain the most wave energy). The hindcast wave rose and associated data from the Stage 2 Report is listed in Figure D-9, and the computed gross and net wave-energy directions relative to the project location are shown in Figure D-10. The net wave-energy direction is the resultant of the gross easterly and westerly wave-energy directions. It should be noted that the net wave-energy direction is almost identical to the angle of the shoreline normal that was discussed and is shown in Figure D-4. This helps to verify the absence of any strong indicators of a predominant littoral drift direction.

The construction of the diffraction coefficient isolines was a trial and error procedure in attempt to determine where the K_D=0.3 isolines from the gross easterly and westerly directions would intersect. As stated before, this intersection point is a clue which tends to indicate where a beach salient may form. So long as this point is lakeward of the shoreline, sufficient wave energy is present to prevent formation of a complete tombolo yet maintain a beach salient. Several different combinations of breakwater length and spacing were analyzed to determine the point of intersection of the isolines, the amount of wave energy entering the gaps, and the anticipated beach configuration. The incident wave criteria that were used to develop the diffraction diagrams were for average to moderate design conditions. This is a 5.0 second wave at an assumed depth of 9.0 feet (+6 LWD). The SPM diagrams that were utilized are Figures (2-50) and (2-51) for B/L=3.0 and B/L=3.8. The breakwater configuration that was selected to provide the necessary protection in the most efficient way is shown in Figure 11. Only the center four breakwaters are shown to best illustrate their layout and the characteristics of the waves passing through the gaps. Breakwater lengths are 300 feet, spacings are 300 feet and the distance offshore is approximately 600 feet. Diffraction diagrams through the gaps are indicated for the net wave-energy direction along with the K_D=0.3 isolines from the gross easterly and westerly wave-energy directions. It is evident by the lakeward intersection of these isolines that substantial wave energy exists to prevent full tombolo formation. The breakwater gaps are also small enough to minimize the amount of wave energy striking the shore at the gaps and to limit the amount of scalloping of the beach beyond what is acceptable. The anticipated shoreline configuration is shown based on the results of the above analyses. Plate D-6 is a plan view of the entire protective beach with the eight offshore breakwaters showing the breakwater spacings relative to the beach.

WAVE ROSE FOR MAUMEE BAY STATE PARK APRIL-DECEMBER

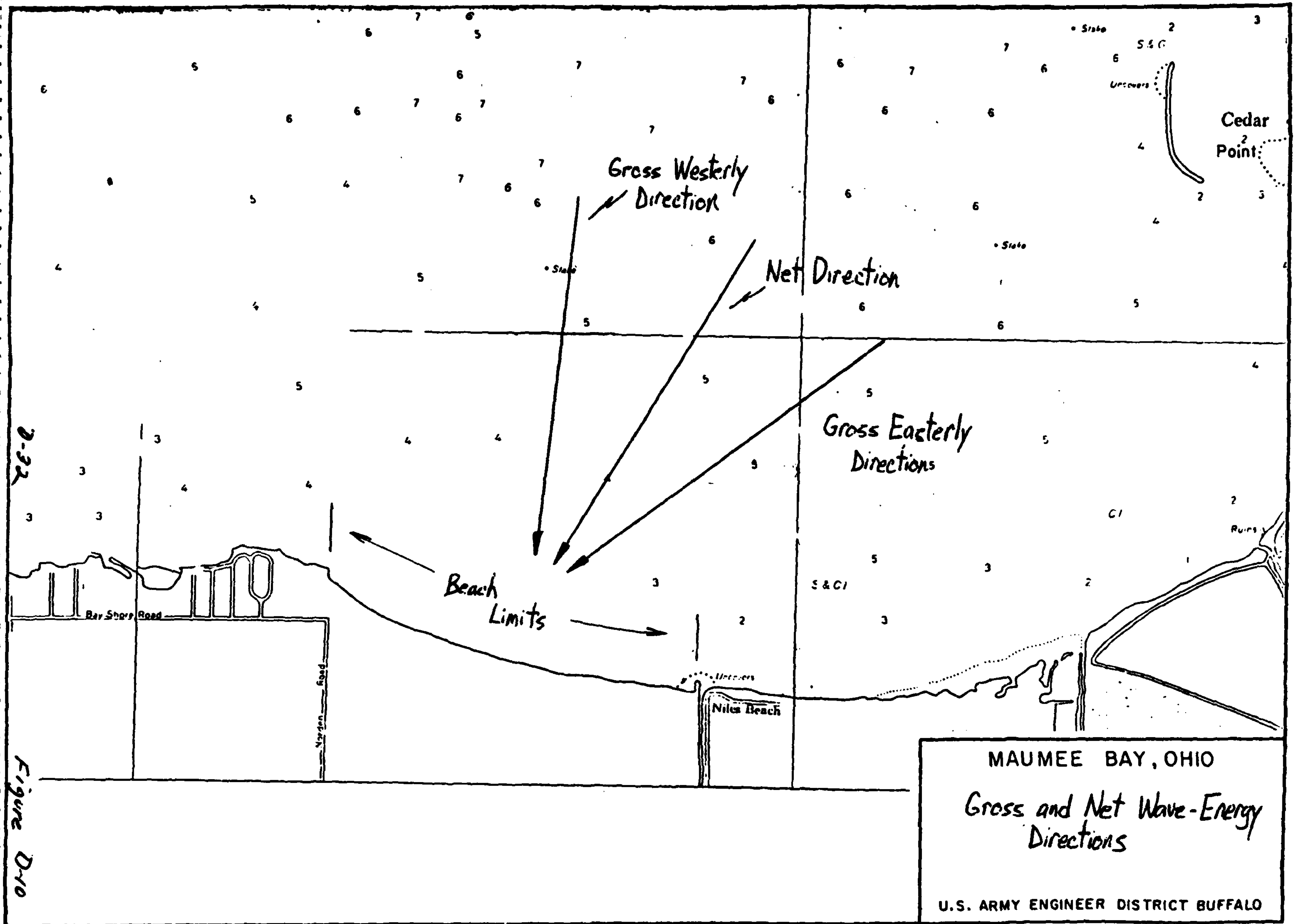


MAUMEE BAY STATE PARK - OFFSHORE AREA
ANNUAL WAVE ROSE (PERCENT FREQUENCY)*

WAVE HT. (ft)	NW	NNW	N	NNE	NE	ENE	E	total
1 - 1.9	3.05	2.38	2.30	1.24	1.29	1.20	1.51	12.97
2.0 - 2.9		1.21	.85	1.35	1.15	1.49	1.32	7.37
3.0 - 3.9		.03	.03	.73	.87	.82	.95	3.43
4.0 - 4.9				.41	.34	.33	.31	1.39
5.0 - 5.9				.06	.13	.22	.10	.51
6.0 - 6.9				.04	.06	.06	.01	.17
7.0 - 7.9				.01	.02	.02		.05
total	3.05	3.62	3.18	3.84	3.86	4.14	4.20	25.89

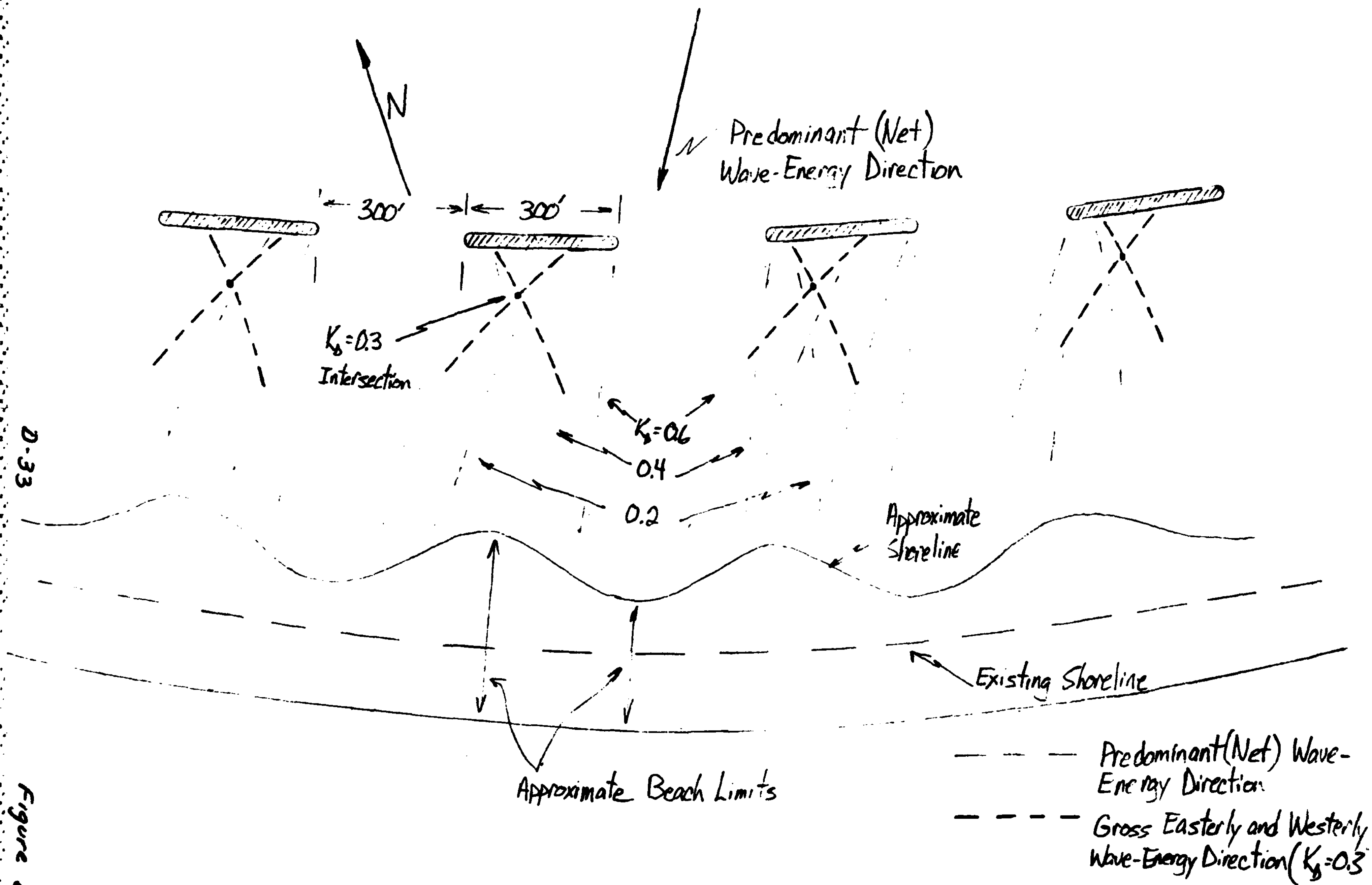
*NOTE Percent frequency is percent of total observations between April and December, inclusive.

Figure D



FIGURE

Figure D-10



N
Predominant (Net) Wave-Energy Direction
300'
300'
K_b=0.3 Intersection
K_b=0.6
0.4
0.2
Approximate Shoreline
Existing Shoreline
Approximate Beach Limits
Predominant (Net) Wave-Energy Direction
Gross Easterly and Westerly Wave-Energy Direction (K_b=0.3

Figure D-11

(c.) Armor Unit Weight

Using Hudsons Formula

$$W = \frac{w_r (H)^3}{K_\Delta (S_r - 1)^3 \cot\theta}$$

Where: w_r = unit weight of stone equal to 155 lbs/ft.³

H = design wave height = 6.5 ft

K_Δ = stability coefficient equal to 2.9 (breaking wave)

S_r = specific gravity of armor Use 2.48

$\cot\theta$ = breakwater slope

$$W = \frac{155(6.5)^3}{2.9(2.48-1)^3 1.5} = 3018 \text{ lbs}$$

W = 1.51 tons

Use 0.9 W to 2.0 W

or <u>1.3</u> to <u>3.0</u> tons

(d) Armor Layer Thickness

$$r = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

$$r = (2)(1.15)\left(\frac{3018}{155}\right)^{1/3}$$

r = 6.2 ft

Where: n = number of armor layers = 2.0

k_Δ = layer coefficient = 1.15

W = 3018 lbs

w_r = 155 lbs/ft.³

A one stone layer thickness will also extend 6.0 ft. over the bedding layer for added toe protection as shown in Plate 7.

(e) Crest Width

$$B = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

$$B = (1.15)(3)\left(\frac{3018}{155}\right)^{1/3} = 9.3 \text{ ft.}$$

Use B = 9.5 ft.

Where n = number of stones across the crest

k_Δ = 1.15

W = 3018 lbs

w_r = 155 lbs/ft³

(f.) Bedding Layer

An underlayer will not be used due to the shallowness of the water. The armor stone will therefore be placed directly on top of the bedding layer. This type of construction was used for the Presque Isle prototype experimental breakwaters which are performing very well. Due to the milder wave climate at Maumee Bay the stability of the breakwaters should therefore be adequate

Use 0.01 W to 0.00125 W

0.01W = 0.01(3018 = 30. lbs

0.00125W = 0.00125(3018) = 3.8 lbs

Use 4 lbs to 30 lbs

Use a 3.0 ft thick layer of bedding stone

A typical cross-section of the offshore breakwaters is shown in Plate 7

(g) Crest Elevation

The crest elevation of an offshore breakwater is of concern since this feature can have significant influence on the formation or non-formation of a salient in the lee of the structure. The previous sections detailed the placement of the breakwaters based on measurements of wave energy through the gaps of the structure and how this energy influences the beach in its lee. Those calculations were based on case studies and experiments where the breakwaters were impermeable and non-overtopped or overtopped infrequently. Therefore if the crest is set too low and is too impermeable, wave transmission over and through the structure can result in transmitted waves that will erode and destroy the beach it was intended to protect. However, if it is a complete barrier the structure is undoubtedly over designed and may also have a tendency to cause tombolo formation. The basis behind setting the crest elevation of the breakwaters is therefore to allow only periodic overtopping to a limited degree which will not jeopardize the beach. The following calculations allow a maximum 3.0 ft transmitted wave under design conditions which is believed to satisfy this criteria. Wave transmission is determined by the Cross and Sollitt technique (Ref. 3) in conjunction with Figs. 7-8 through 7-15 of the SPM for calculating wave runup.

Determine Wave Runup

$H_o' = 8.0$ ft. $\quad H_i = 6.5$ ft.

$T = 6.9$ secs $\quad H_o'/gT^2 = .0052$

$L_o = 244$ ft. $\quad d_s/H_o' = 1.36$

$d_s = 10.9$ ft $\left(\begin{smallmatrix}+7.9\\ LWD\end{smallmatrix}\right)$

From Fig. 7-10 SPM for $d_s/H_o' = 0.8$ $\quad R/H_o' = 2.8$

$d_s/H_o' = 1.36$ $\quad R/H_o' = 2.68$ (Interpolated Value)

Fig. 7-11 (SPM) for $d_s/H_o' = 2.0$ $\quad R/H_o' = 2.55$

$\therefore R_{SMOOTH} = 2.68(8.0) = 21.5$ ft

From Fig. 7-13 (SPM) $\quad k = 1.206$

$\therefore R_{\substack{SMOOTH\\ACTUAL}} = (21.5)(1.206) = 25.85$ ft.

From Fig 7-15 $\quad R/H_o'{}_{RIPRAP} = 1.15$

$$\text{Rough slope correction} = \frac{R/H_o'{}_{RIPRAP}}{R/H_o'{}_{SMOOTH}} = \frac{1.15}{2.68} = 0.43$$

$R_{RIPRAP} = (0.43)(25.85) = 11.11$ ft.

This runup is overestimated due to the fact that Figs. 7-8 through 7-11 and 7-14 through 7-18 are from tests with a 1:10 slope, whereas the actual beach slope at Maumee Bay is approximately 1:100. Therefore to remedy this discrepancy we use Goda's charts to calculate the wave heights

at the toe depth for the 1:10 slope and for the 1:100 slope. The runup from the SPM calculations can be reduced by the ratio of the two waveheights (see NCDED-C 22 August 1978 Guidance for Calculating Decay of Significant Wave Heights in the Surf Zone).

1:10 slope : $H_{s16}/H_o' = 1.11$

1:100 slope : $H_{s16}/H_o' = 0.81$

$$\therefore \frac{H_{s16}/H_o'\ _{1:100}}{H_{s16}/H_o'\ _{1:10}} = \frac{0.81}{1.11} = 0.73$$

$\therefore$ Actual Runup = (0.73)(11.1) = 8.1 ft.

Crest Elevation:

Using Cross and Sollitt Technique

$$K_T = \frac{H_T}{H_I} = 0.54\left(1.04 - H_{b_i}/R\right)$$

Where: H_T = transmitted wave height = 3.0 ft.
H_I = incident wave height = 6.5 ft.
H_{b_i} = crest height above design water level
R = wave runup = 8.1 ft.

$$H_{b_i} = R\left(1.04 - \frac{H_t}{.54 H_i}\right)$$

$$H_{b_i} = 8.1\left(1.04 - \frac{3.0}{.54(6.5)}\right)$$

$$H_{b_i} = 1.5 \text{ ft.}$$

Crest Height = 1.5 + 7.9 = +9.4 ft. LWD

Therefore the crest elevation must be 9.4 ft. above LWD to allow a maximum 3.0 ft. transmitted wave.

BY YB DATE 7/22 SUBJECT Maumee Bay - Breakwater Gap Velocities SHEET NO. .... OF ....
CHKD. BY .... DATE .... JOB NO. ....

(h.) Velocity Through Breakwater Gaps

Depending on breakwater crest elevation, spacing, length and other design features of a segmented breakwater system, the seaward flow of water back through the breakwater gaps can be undesirable. High velocities can be a hazard for numerous reasons especially if they are such that they transport sand out of the breakwater area. This analysis is performed to compute the velocities through the gaps and determine if they are critical to the proposed breakwater design. This is done based on Coastal Engineering Technical Aid No. 80-8, "Estimation of Flow Through Offshore Breakwater Gaps Generated by Wave Overtopping", by William N. Seelig and Todd L. Walton, Dec 1980 Ref. 10 .

For design wave conditions

$R = 8.1$ ft.	$B = 300$ ft
$H_o' = 8.0$ ft	$l = 300$ ft.
$A_{ce} = 10,300$ ft	$h = 12.4$ ft.
$C_d = 0.8$	$F = 1.5$ ft.
$C_{de} = 1.0$	$N = 8$
$d_s = 10.9$ ft	$T = 6.9$ secs

Where: R = wave runup
H_o' = deepwater wave height
C_d, C_{de} = discharge coefficients
A_{ce} = cross sectional area
d_s = design depth
B = breakwater length
l = breakwater spacing
h = breakwater height
F = freeboard = $h - d_s$
N = # of breakwaters
T = wave period

$$q_o = (g\, Q_o^* H_o'^3)^{1/2} \left(\frac{R-F}{R+F}\right)^{\frac{.1085}{\alpha}}$$

Where: q_o = overtopping rate
Q_o^*, α = overtopping parameters equal .019 and .053 respectively from Fig. 2 (Ref. 10)

$$q_o = \sqrt{(32.2)(.019)(8.0)^3} \left(\frac{8.1-1.5}{8.1+1.5}\right)^{\frac{.1085}{.053}}$$

$q_o = 8.03$ ft³/sec/ft of breakwater

$P/H_o' = 0.6e^{-(-.7+F/H_o')^2}$ where P = Ponding Level

$P = (8.0)\,0.6\,e^{-(-.7+\frac{1.5}{8.0})^2}$

$P = 3.69$ ft.

$K = \dfrac{\sqrt{2gP}\left[C_d B d_s (N-1) + 2C_{de} A_{oe}\right]}{q_o \ell N}$ Where K = dimensionless parameter for Input to Fig. 5

$K = \dfrac{\sqrt{2(32.2)(3.69)}\left[0.8(300)(10.9)(8-1) + 2(1.0)(10{,}300)\right]}{8.03(300)(8)}$

$K = 31.1$

From Fig. 5

$\dfrac{\bar{V}}{C_d\sqrt{2gP}} = .03$

$\bar{V} = (.03)(0.8)\sqrt{64.4(3.69)}$

$\bar{V} = 0.37$ ft/sec.

As recommended in the above referenced technical paper, velocities greater than 0.5 ft/s. could transport significant quantities of sediment out of the system. Since the calculated velocity is 0.37 ft/sec. the local water velocities at the breakwater gaps should not be a problem.

(2) Protective Beach - During the 30 January 1980 orientation workshop meeting, matters concerning the size and design of the protective beach as designed in the Stage 2 Report were discussed. Regarding the size of the protective beach, it had been determined that due to the protection provided by the offshore breakwater system, the amount of beachfill necessary for the protective beach could be considerably reduced. Also the width of the beach berms, the location of the storm dune, and possibility of substituting grassy areas for sand areas was discussed. Based on the anticipated beach fill losses, the probable reshaping of the beach and on the discussions of the meeting, two new options for the protective beach are presented. More detailed information in regards to littoral processes for Maumee Bay for this alternative is found in the Coastal Processes Section.

(a) Size and Configuration - Option 1 (Alternative 3a) - This option is identical to Alternative 2a except the beach is recessed into the existing shoreline approximately 100 feet. The beach berm widths, elevations, and slopes all remain the same. This configuration shown in Plate D-8 requires approximately 210,000 yards^3 of sand or three-fourths of that required for the unprotected beach alternative, yet provides the same beach area. Some excavation of the existing beach berm down to elevation +4.5 feet would be necessary, however, the material could be used for the vegetated storm dune. The cross section shown represents a typical, stable beach configuration and an average cross section of what is needed to protect the existing land. Due to the presence of the breakwaters, the beach will adjust with accretionary areas in the lee of the breakwaters and erosion areas in the gaps. With the relatively long distance from shore at which the breakwaters will be placed and due to the usually mild wave conditions, the scalloping of the beach will not be severe. During normal seasonal wave activity, the 60-foot foreshore berm will erode to 20 to 40 feet at the gaps of the breakwaters and the beach will build in the lee of the breakwaters from the eroded sand. This adjusted beach profile is determined to be the least necessary to provide protection to the existing land during major storms, which will further erode and readjust the beach. The foreshore berm would, therefore, be maintained on a yearly basis to a minimum width of 20 feet. Due to the presence of the breakwaters, longshore transport of the beachfill will be considerably reduced and required backpassing of material will be negligible. The material that cannot be recovered, will be lost to offshore areas by means of wave action and also be aoelion transport. An estimate of annual losses which will be replenished by annual nourishment is calculated to be approximately 5,000 yards.^{3} An explanation of this quantity is found in the Coastal Processes Section. The 1 vertical to 20 horizontal beach slope was set in accordance with SPM criteria for medium sand fill and also on the anticipated beach slope based on other similar projects.

Option 2 (Alternative 3b) - This option has been presented in order to further reduce the quantities of beach fill necessary for the protective beach by substituting a grassy area in a portion of the sand beach. The design as shown, in Plate D-9 requires approximately 170,000 yards^3 of sand,

but would require additional fill material for the grassy area. As with Option 1, the total recreational area remains the same and the beach would still provide the necessary protection. The cross section shown represents typically a stable beach configuration and an average cross section needed to protect the existing land. The beach will adjust similar to Option 1 with erosion at the gaps of the breakwater and accretion in the lee of the breakwaters. With the forshore berm at a higher elevation (see the following Section, Beach Berm Elevations) the amount of berm erosion will not be as severe. During normal seasonal wave activity, the 50-foot berm will erode to 20 to 40 feet at the gaps and the beach will build in the lee of the breakwaters from the eroded sand. This adjusted profile is determined necessary to protect the existing land during major storms, which will further erode and readjust the beach. The foreshore berm would therefore be maintained on a yearly basis to a miminum width of 20 feet. Annual nourishment rates still remain at 5,000 yards^3 as is explained in the Coastal Processes Section. The 1 vertical to 20 horizontal beach slope was set in accordance with SPM criteria for medium sand fill and also on the anticipated beach slope based on other similar projects.

(b) Beach Berm Elevations - The beach berm elevations were set such that little or no overtopping would be allowed. Overtopping is not desirable since it would tend to increase sand losses by overwash and would increase offshore losses by pumping through the sand face. Despite the presence of the breakwaters significant energy will be present at the breakwater gaps, which warrants consideration for full design wave conditions. As with Alternative 2, both options for Alternative 3 will terminate at +10 feet to prevent overtopping during rare storm events. This was determined in accordance with CETA 78-2 (Ref. 12). The vegetated storm dune extends another 2 feet to +12 feet for both options to prevent sand overwash due to extremely rare storm events while the majority of the berm acts to retain the beach fill.

(3) Jetties, Wildlife Revetment, Berger Ditch Revetment

(a) Plan and Layout - The jetties, wildlife revetment, and Berger Ditch revetment as designed for Alternative 2a all remain nearly identical for Alternatives 3a and 3b. The alignment, positioning, cross sections, and structure lengths remain the same with exception of the jetties. The only difference being that the jetty at the west end of the protective beach for Alternatives 3a and 3b is reduced to 250 feet in length. This is possible because of the smaller beach cross sections and due to the stability provided to the beach by the offshore breakwaters. The plan views and cross sections of these features are shown on Plates D-3, D-4, and D-5.

d. Alternative 5 - West Shore Revetment, Wildlife Revetment.

As stated in the Conclusion Section of the Stage 2 Report, other means of preventing shoreline erosion other than a protective sand beach would be considered in Stage 3. This led to designing a rubblemound revetment which is believed to be the most effective and economical way of preventing erosion. This would satisfy the shore erosion need but would not satisfy the recreational need since there would not be any sand beach included.

The revetment (West Shore Revetment) would extend from McHenry Ditch and intersect with the Berger Ditch revetment near Berger Ditch in the same fashion as the protective beaches. The plan and layout of this alternative are shown on Plate D-10. Since the revetments only purpose is to prevent erosion there is no need for jetties since the clogging of the ditches would be minimal. The Berger Ditch revetment and the wildlife revetment remain identical to Alternatives 2a, 3a and 3b since their purpose does not change.

(1) <u>West Shore Revetment</u>

(a) Plan and Layout - The west shore revetment is a rubblemound structure extending approximately 5,500 feet from McHenry Ditch intersecting the Berger Ditch revetment near Berger Ditch. The revetment would be constructed on dry land near the waters edge with the sole purpose of preventing shoreline erosion. Since jetties will not be required due to the absence of any beach fill, it will be necessary to extend the revetment up McHenry Ditch approximately 50 feet. On the eastern end the revetment will tie in directly with the Berger Ditch revetment. A cross section of the revetment is shown on Plate 11 and is very similar to the Berger Ditch revetment, except the crest elevation is somewhat higher. The calculations for the stone sizes, layer thicknesses, and elevations of the revetment are found on pages D-44-D-46.

(b) Armor Unit Weight

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot\theta}$$

Where: $w_r = 155$
$H = 5.0$ ft. breaking
$K_D = 3.5$
$S_r = 2.48$
$\cot\theta = 2.0$

$$W = \frac{(155)(5.0)^3}{3.5(2.48-1)^3(2.0)}$$

$W = 853$ lbs

Use $0.9W$ to $2.0W$

or 768 lbs to 1706 lbs ⇒ Use 750 lbs to 1700 lbs

(c.) Armor Layer Thickness

$$r = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

Where $n = 2$
$k_\Delta = 1.15$
$W = 853$
$w_r = 155$

$$r = (2)(1.15)\left(\frac{853}{155}\right)^{1/3}$$

$r = 4.1$ ft. ⇒ Use $r = 4.0$ ft.

(d) Crest Width

$$B = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

where $n = 3$
$k_\Delta = 1.15$
$W = 853$
$w_r = 155$

$$B = (3)(1.15)\left(\frac{853}{155}\right)^{1/3}$$

$B = 6.1$ ft.

Use $B = 6.0$ ft.

(e.) Underlayer (Bedding Stone)

Use 0.2 W to 0.06 W

$0.2W = 0.2(853) = 170$ lbs
$0.06W = 0.06(853) = 52$ lbs

Use 50 to 170 lbs

Underlayer stone will be used as bedding stone and will be placed directly on top of a filter cloth. Armor stone will also extend 5 ft. over the top of the underlayer to provide protection to the underlayer against sc

(f.) Crest Elevation

$H_o' = 8.0$ ft $H_i = 5.0$ ft $\cot \theta = 2.0$
$T = 6.9$ secs $H_o'/gT^2 = .0052$
$L_o = 244$ ft
$d_s = 7.9$ ft $d_s/H_o' = 0.98$

From Fig 7-10 (SPM) for $d_s/H_o' = 0.8$ $R/H_o' = 2.45$

$d_s/H_o' = 0.98$ $R/H_o' = 2.46$ (Interpolated Value)

From Fig 7-11 (SPM) $d_s/H_o' = 2.0$ $R/H_o' = 2.48$

$\therefore R_{SMOOTH} = 2.46(8.0) = 19.7$ ft

From Fig 7-13 (SPM) $k = 1.19$

$\therefore R_{SMOOTH} = (19.7)(1.19) = 23.5$ ft.

From Fig. 7-15 (SPM) $R/H_o'{}_{RIPRAP} = 1.32$

Rough Slope Correction $= \frac{R/H_o' {}_{RIPRAP}}{R/H_o' {}_{SMOOTH}} = \frac{1.32}{2.46} = 0.54 \quad \therefore R_{RIPRAP} = (.54)(23.5) = 12.7$ ft.

Apply Slope Correction Factor

$H_{sis}/H_o'{}_{1 on 1.0} = 0.62$

$H_{sis}/H_o'{}_{1 on 10} = 0.94$

$\frac{0.62}{0.94} = 0.66$

Actual Runup $= (12.7)(.66) = 8.4$ ft.

Crest Elevation:

The revetment will be built on top of a clay core in order to minimize flooding and to reduce construction costs. A maximum 1.0 ft transmitted wave will be allowed without causing excessive damage to the structure or the land it is protecting.

Using Cross and Sollitt Technique

$K_T = \frac{H_T}{H_I} = 0.54(1.04 - H_{b_i}/R)$

Where H_T = transmitted wave height = 1.0 ft.
H_I = incident wave height = 5.0 ft.
H_{b_i} = crest height above design water level
R = wave runup = 8.4 ft.

$H_{b_i} = R\left(1.04 - \frac{H_T}{.54 H_i}\right)$

$H_{b_i} = 8.4\left(1.04 - \frac{1.0}{.54(5.0)}\right)$

$H_{b_i} = 5.6$ ft.

Crest height $= 5.6 + 7.9 = +13.5$ ft LWD

Therefore the crest elevation must be 13.5 ft above LWD to allow a maximum 1.0 ft transmitted wave.

(2) Berger Ditch Revetment, Wildlife Revetment

(a) Plan and Layout - The Berger Ditch revetment and the wildlife revetment retain the same designs, layouts and cross sections as that for Alternatives 2a, 3a and 3b. Cross sections of these are shown in Plates D-4 and D-5.

D4. COASTAL PROCESSES

a. Glacial History.

The availability of sand in the nearshore, the erodibility of the shore material, the morphology of Maumee Bay, in fact its very existence are all the result of a condition inherited by Lake Erie from the Pleistocene Epoch glaciers. Glacial sequences of advance and retreat scoured the basin of the Great Lakes, deposited the surficial sediment, and etched the area with an evolving drainage pattern.

The last glacial advance in Ohio occurred about 19,000 years BP (before present) and extended into southern Ohio to approximately the present day banks of the Ohio River Valley. By 14,000 years BP, the ice sheet had retreated to a location equivalent to the northern boundary of Ohio. South of this ice sheet, a glacial lake formed covering an area extending 40 miles south of Maumee Bay. Lake Maumee, with a surface elevation of 800 feet, drained to the southwest through the area which is presently Ft. Wayne, IN, into the Mississippi River system and was about one and one-half times larger than the present Lake Erie. As the ice sheet melted further, the lake level dropped. By 12,000 years BP, the ice sheet had retreated to the Niagara escarpment and an eastward discharge through the Niagara River developed. At this time, the outlet was about 100 feet below its present elevation which caused Lake Maumee to drain. The primative Maumee River extended across a broad mudflat (the old lake bottom) as far east as the present city of Erie, PA, where a small lake probably persisted in the deepest portion of Lake Erie Basin.

During progressively increasing lake stages from 12,000 to 4,300 years BP, the western basin bottom was subjected to subaerial erosion and included shallow, marshy areas and small ephemeral lakes in some of the surface depressions. As the Niagara escarpment experienced isostatic rebound, due to the missing weight of the glaciers, water ponded and slowly advanced westward across the central Lake Erie Basin. Tributary streams such as the Maumee River were shortened as the lower ends were drowned by the rising lakes. A buried bedrock channel which is located just north of the present shipping channel across Maumee Bay probably indicates the former location of the Maumee River (Benson, 1975, Ref. 1).

It was not until about 5,000 years BP that water reached as far west as the Erie Islands. Modern Lake Erie evolved around 3,500 years BP when the lake level was at about 550. The lake level has been slowly rising ever since in response to the continuing isostatic rebound of the Niagara River outlet. In addition, there is differential isostatic rebound of the north and south shores of the lake which causes more rapid inundation of the south shore of Lake Erie.

These combined effects result in a regressive shore characterized by eroding bluffs, progressive flooding of low-lying areas and drowned river mouths.

b. Surficial Deposits.

One effect of the glacial history of the Maumee Bay area is seen in the deposits of glaciolacustrine clay which characterize the bottom sediments of southern Maumee Bay and dominate the southern shore of the bay forming a low (1 to 5 foot) bank. These deposits were derived from material carried by melt waters from the glacier front or material carried into the lake basin by streams. These glaciolacustrine deposits are typically medium to dark gray or gray-brown, silty clays which vary in thickness from 1 foot to almost 30 feet and overlie a thick till deposit. In some localized areas, the till surface is exposed. The shore and offshore of Maumee Bay contains the previously mentioned glaciolacustrine clay deposits, and glacial tills and also littoral sand deposits and recent organic muds.

The only sand deposits of any importance in Maumee Bay is a modified spit which extends north-northwest from Cedar Point toward Turtle Island. This deposit is used as a commercial source of sand and is described in Hartley (1960, Ref 5) and Herdendorf and Cooper (1975, Ref. 6). The nearshore sand deposit off of Little Cedar Point probably originated as a result of littorally transported material from the eastern portions of Lucas County, moving northwest off of the end of Cedar Point. Since 1877, the subaerial portion of the Cedar Point spit has swung 70° to the west, possibly as a result of more limited littoral supply from the east (due to private shore protection works), artificial stabilization of the main body of Cedar Point, and a continuing rise in lake level. The local current pattern moves northwesterly from Cedar Point toward Turtle Island with a secondary flow around Cedar Point to the southwest. This secondary flow carries some material into the bay and is responsible for the occasional beach deposits along the west side of Cedar Point. Except for short reaches of sand on the bay side of Cedar Point, the bay has practically no beaches.

Data presented in Hartley (1960) and McBride (1975, Ref. 7) indicate that other pockets and zones of sand-dominated sediment can be found throughout the bay, particularly south of North Cape in the north bay and in the south bay between South Shore Park and the Toledo dredged channel (Figure D-12). The sorting and definition of these deposits are weak, but they may be the result of past littoral transport south from North Cape or more likely a lag deposit left behind as the result of winnowing and removal of the fine-grained exposed till.

Recent mud deposits cover large areas of Maumee Bay, particularly collecting in topographic lows such as the 28-foot deep dredged Toledo Harbor channel (Ref 4). These recent mud deposits are probably derived from the suspended sediment load of the Maumee and Ottawa Rivers, turbidity from Lake Erie, and erosion of the glaciolacustrine clay banks and nearshore (Figure D-13).

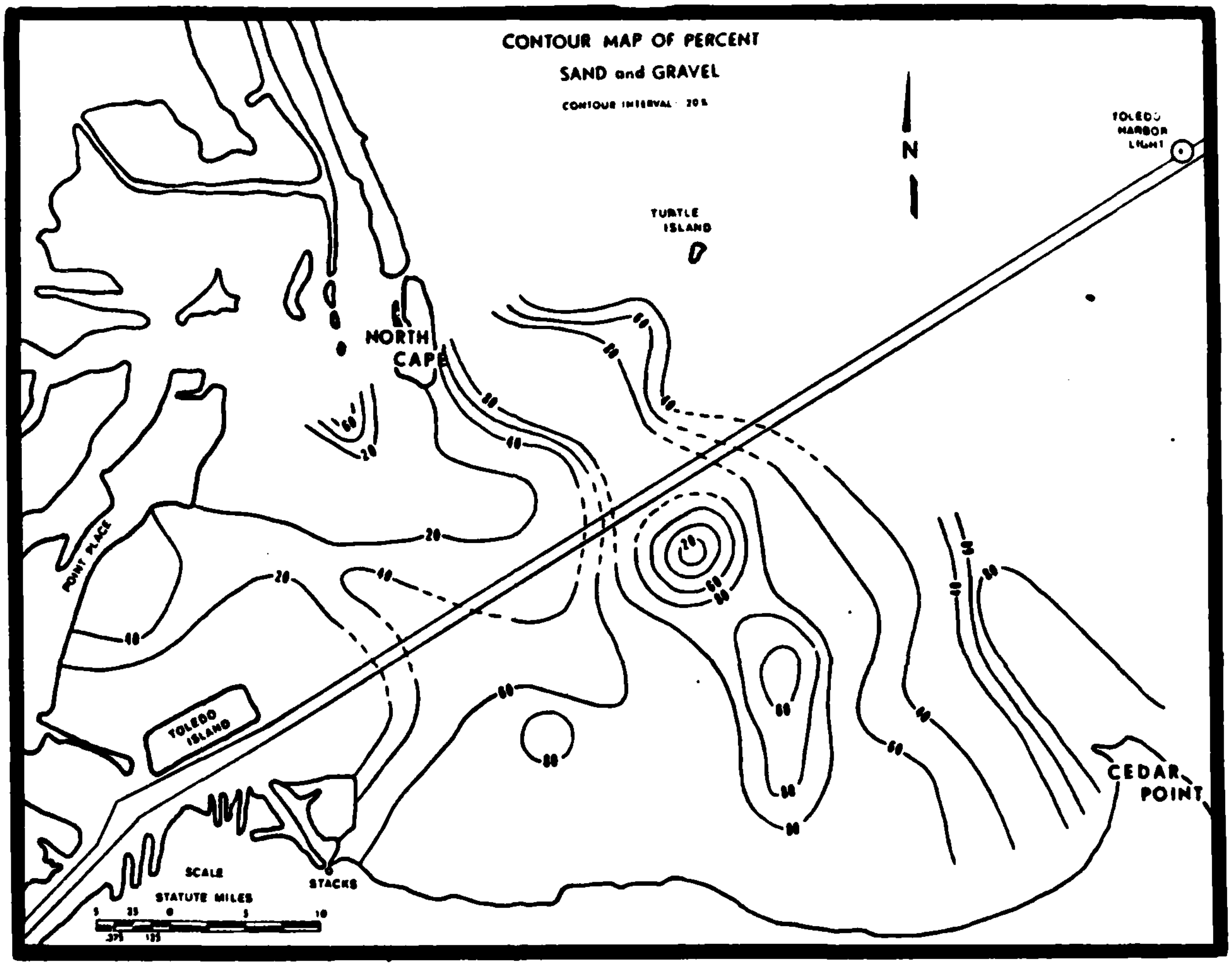


Figure D-12 - Map of Percent Sand and Gravel Distribution of the Recent Sediments in Maumee Bay (McBride, 1975)

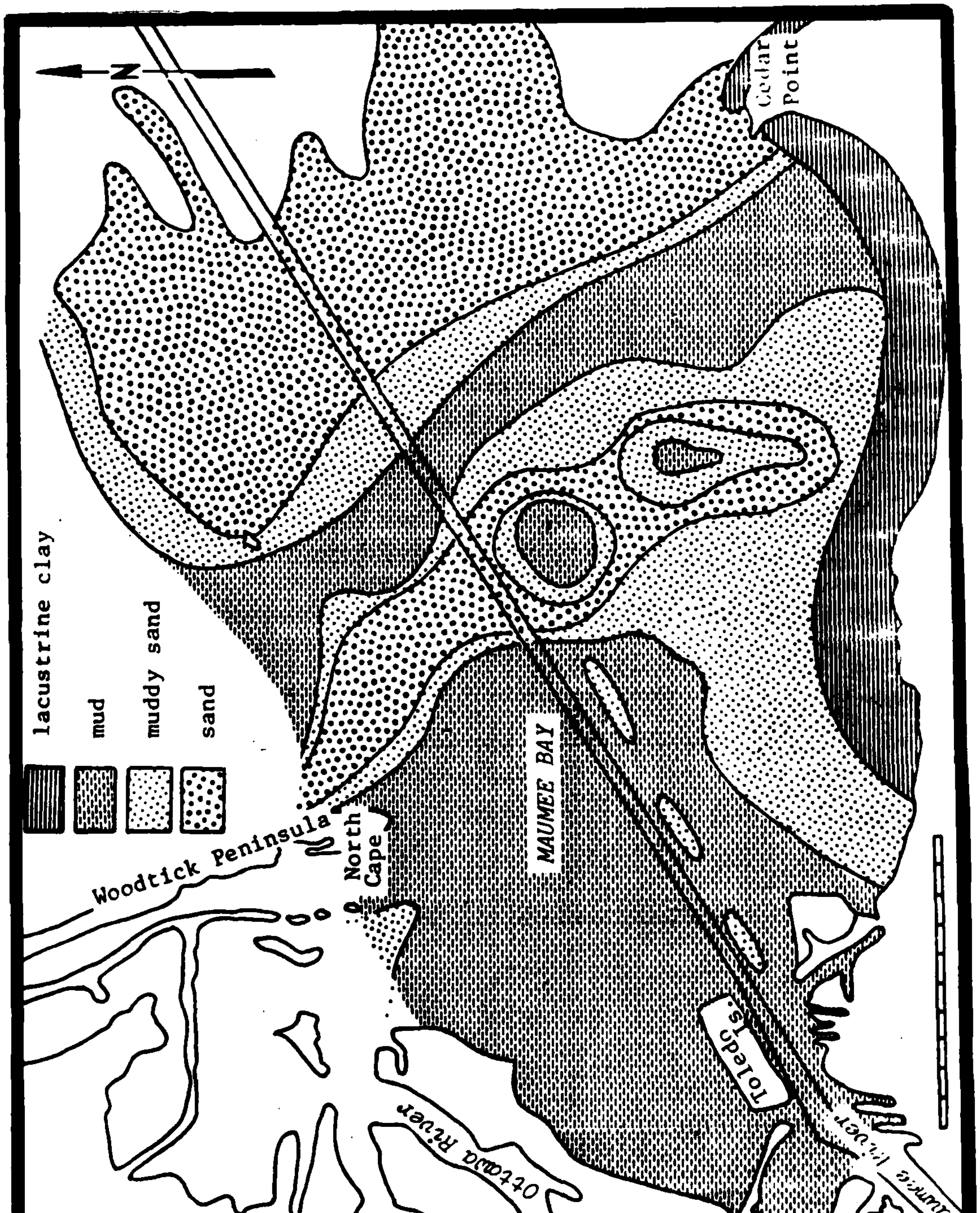


Figure D-13 - Maumee Bay Bottom Sediments (Benson, 1975)

c. Recent Processes.

The four native surficial sediments of Maumee Bay and the southern shore (i.e., glaciolacustrine clay, glacial till, littorally transported sand and recent muds) can be significantly reworked, buried, or transported by the weathering and erosion processes of wave action, winds, surface runoff, currents, ice, and mass wasting.

McBride (1975) divided the bay into three areas based on the energy conditions and subsequent sediment grain size characteristics (Figure D-14): (1) wave and current dominated, characterized by relatively high energy conditions and relatively coarse-grained, well-sorted sediments (area extending from Cedar Point to North Cape); (2) wave dominated, characterized by moderate energy conditions and relatively coarse-grained, poorly sorted sediments (area covering the bay south of the Toledo Harbor entrance channel including the project area); and (3) sheltered areas characterized by low energy conditions and fine-grained, poorly sorted sediments (area north of the Toledo Harbor entrance channel and the area just west-southwest of the subaqueous Cedar Point spit).

A presentation of these domains serves to accent the value of wave action in influencing the observed sediment transport patterns. The shallowness of the bay and the shore and shoal geometry directly effected the sediment transport potential of various areas of the bay. The spoil banks formed from past harbor dredging operations and the subaqueous Cedar Point spit are barriers which subdivide the bay into short fetch areas. Northwest waves are blocked from the south shore by the spoil banks. Waves from the east are blocked by Cedar Point and spit. Thus, in the project area, the main wave approach angles are those infrequent waves from the north through northeast (Figure D-15). Onshore winds from the north-northeast, and east quadrants occur on the average of 98 days per year and are generally weaker than the winds from the shore direction (south and southwest). (Benson, 1975).

Thus, at Maumee Bay State Park, the more frequent waves for the northwest have a shorter fetch, while the waves from the northeast have a longer fetch, but are less frequent and tend to experience significant refraction. Waves from the north have the greatest fetch (approximately 50 miles), but these wave crests approach parallel to the shore and generate little net sediment transport dominance. For all wave approach angles, the shallow bathymetry of the bay causes "deep water" waves to break continuously before they reach shore.

Still, wave action is the single most important physical process of shoreline erosion for Maumee Bay. The shallow water breaking waves cause scour of the offshore glaciolacustrine clays, steepen the slope and erode the sand and gravel deposits of Cedar Point and offshore of the south shore. Because waves can break at any point within Maumee Bay, all underwater features can actively influence and interact with the shore features. Offshore sand deposits can temporarily nourish the shore and topographic highs can reshape the local wave climate.

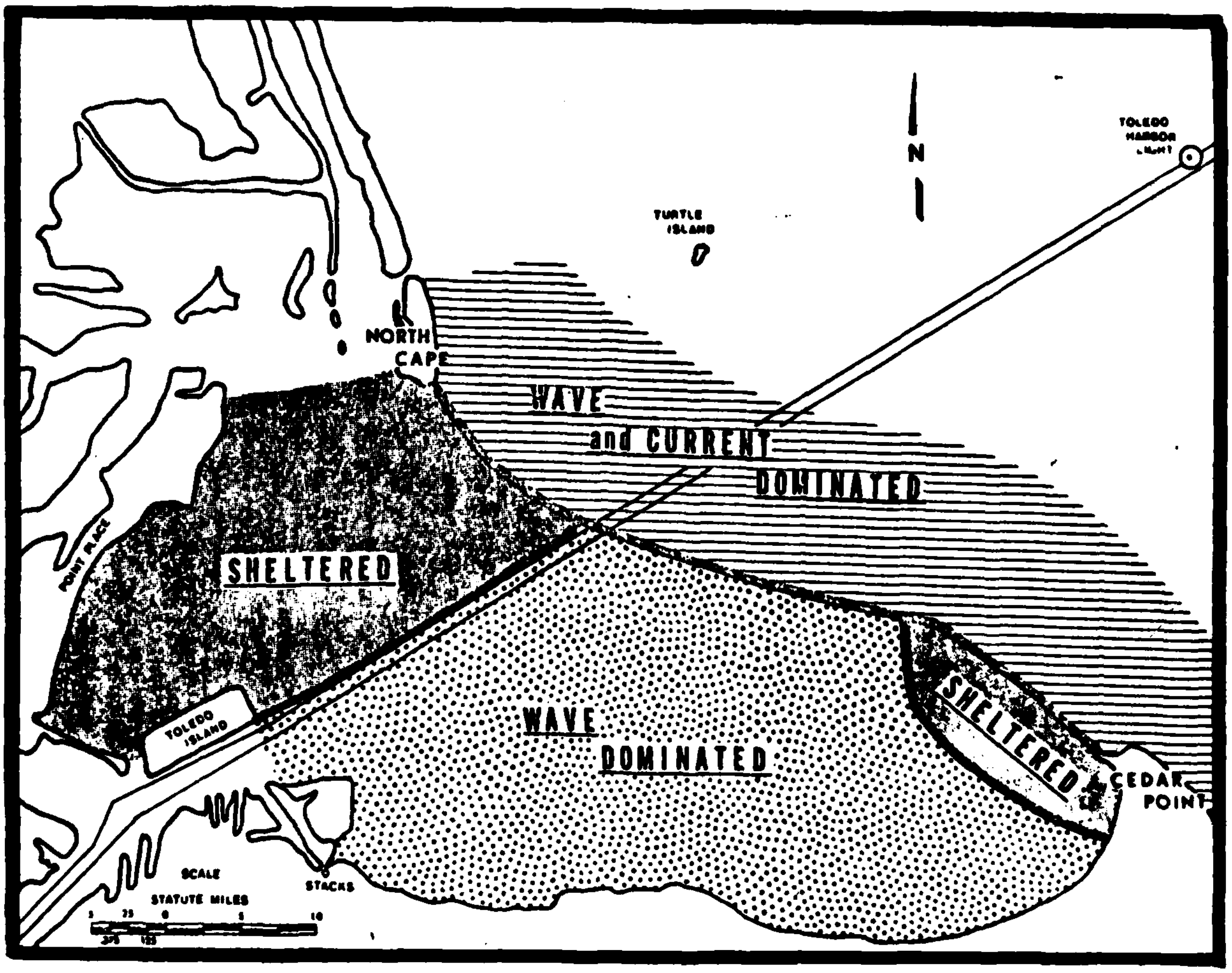


Figure D-14 - Energy Domains in Maumee Bay (McBride, 1975)

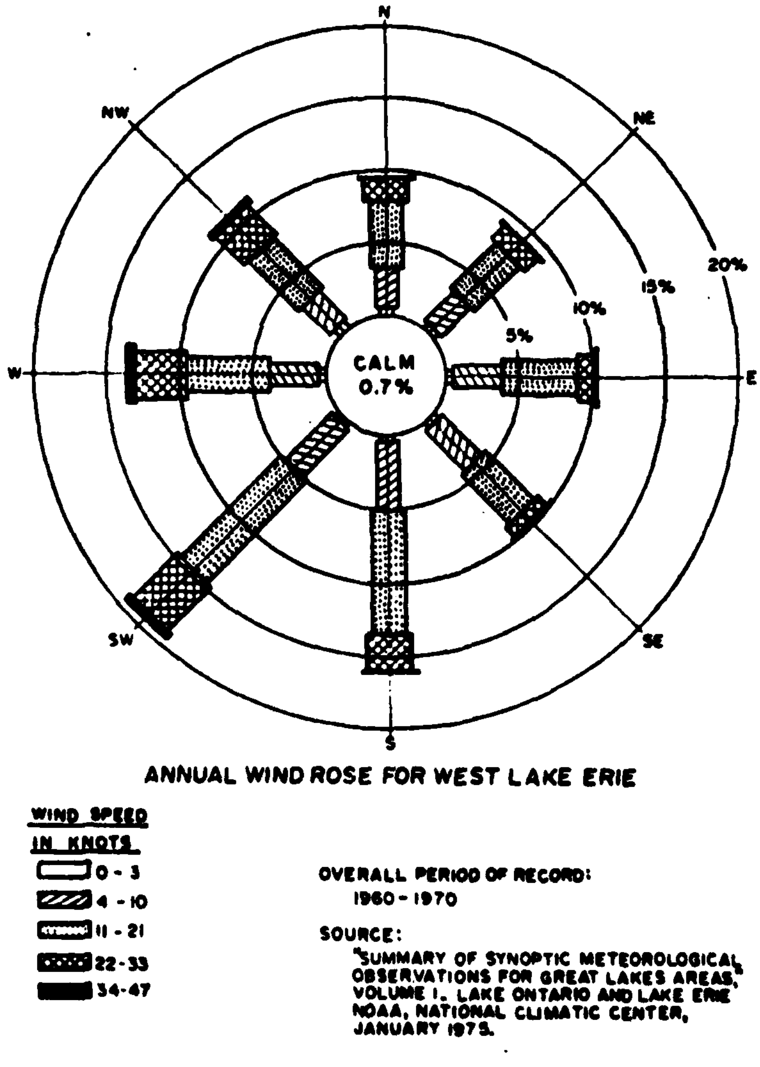


Figure D-15 - Annual Wind Rose for West Lake Erie

Waves which reach the shore meet a highly erodible material as the low clay banks of the south shore rapidly disintegrate under moderate wave attack. Wave action and littoral currents constantly remove the material which accumulates at the foot of the backbeach bank transporting it either offshore or alongshore. Because the majority of the Maumee Bay shoreline materials are fine-grained silts and clays, most of this material is carried offshore. Fresh surfaces are exposed and the erosion process continues.

The littoral currents in Maumee Bay are poorly understood as there is so little littoral material available to document net trends. Although the littoral system was responsible for the formation of the Cedar Point spit and the accumulation of sand in the nearshore northwest of Cedar Point, the many man-made shore protection structures to the east have drastically reduced the input of sand to the area and growth has ceased.

The shallow nature of Maumee Bay and the limited fetch distances greatly reduce wave activity in the bay, thus reducing littoral currents. Also, the glaciolacustrine deposits which comprise the shore and the nearshore zones contain very little potential littoral drift. Benson (1978, Ref. 2) speculated that the wave climate does create a condition in Maumee Bay such that two nodal points exist (one at Niles Beach and one at Immergrum) and that there is very little net littoral dominance. The shore fronting Maumee Bay State Park contains some minor evidence of a westerly drift at the west end and northeasterly drift at the east end. This evidence is in the form of small emphemeral pocket beaches which occassionally appear near the Norton Ditch and Berger Ditch structures and shoals which may develop in front of the Anderson Ditch outlet. However, even in these cases, the littoral drift interpretation is highly suspect as the observed sedimentation pattern probably is more the result of local structure sheltering than of the dominant drift direction.

A longshore energy flux evaluation was developed for the Stage II Report based on shipboard observations (SSMO) of winds for western Lake Erie. This study concluded that there is a dominate longshore transport toward the west. Although the magnitude of this calculation is suspect due to the numerous elements which shelter the south shore, the dominance of a westerly transport is realistic.

Because of the very poorly defined littoral documentation (as in the literature, observable, and through calculations), it was decided to initiate two Littoral Environmental Observation Stations at Maumee Bay State Park. These were established in April 1981. One station is located approximately 1,500 feet east of Norton Road and the other station is about 1,200 feet east of Berger Road. The location of these two stations should assist us in identifying the local wave energy climate, dominate drift direction, and the presence of any nodal zone in this area. The first year of data (CY 1981) has been evaluated on page D-62 and a summary of these data is provided as Supplement 1 to this Appendix.

Maumee Bay is highly sensitive to lake level fluctuations because of its shallowness and the low relief of the adjoining land. Scour in the bay, shore erosion rates, and flooding are all subject to change in response to the lake level. Water levels on Lake Erie varies from year to year and from month to month. Locally, water levels vary from day to day and from hour to hour. The seasonal variations usually consist of high levels in May and June and low levels in January and February. Yearly and seasonal fluctuations are caused by variations in precipitation rates within the Great Lakes Basin. Short-term fluctuations lasting from a few hours to several days are caused by meterological disturbances. Differences in barometric pressure and winds blowing over the surface of the lake create temporary water level fluctuations which vary locally. Astronomical tides are assumed to have a negligible influence on water levels in Maumee Bay.

Changes in lake level and wave action influence not only the shore process of littoral transport, but also the processing of mass wasting and weathering. The parameters which influence the erosion rate of the glaciolacustrine south shore clays are the cohesive resistance which is controlled by grain size, unit weight and water content and the physiography of the shore. Mass wasting is most important in bluffed areas of the shore where groundwater seepage and gravity dominate, whereas wave action and weathering appear to have a greater effect on clay plain shorelines such as that which characterizes Maumee Bay State Park (Benson, 1975).

Weathering is the in-place decomposition of the surface which can lessen the stability of the shoreline materials and make them much more susceptible to erosion and mass wasting. The most common weathering agents which influence Maumee Bay State Park bluff recession are freeze-thaw and slaking. Freeze-thaw weathering is caused by the expansion and contraction of pore water within the soil. Slaking is the crumbling caused by saturation of the clay with water and then drying. Both processes cause a swelling and contraction of the soil surface which can cause it to crumble into a pile of granular clay particles which can readily be eroded under even mild wave conditions.

Thus, the present condition of the Maumee Bay State Park area is one where wave crests approach the shore at a very low angle, generating some dominance for net longshore transport to the west. The only sand natively found along the shore appears to be brought in from the offshore Cedar Point shoal or an offshore lag till deposit. The clay banks are highly erodable due to winter freeze-thaw and summer wet-dry cycles which disintegrate it allowing a small lake level setup with mild wave action to carry large quantities of the material offshore. Areas of adjoining shores show remarkable resistance to erosion with only moderate levels of protection.

d. Historical Shoreline.

Although the historical shoreline, extending back to glacial and postglacial times, ranged from many miles inland of the present shore to as far east as Erie, PA, the modern Lake Erie shore at Maumee Bay State Park has been continually receeding. The earliest accurate documentation of the Maumee Bay shoreline is a U. S. Lake Survey Map dated 1877. Benson (1975, 1978) compared the shoreline position and recession rates from 1877 to 1940,

1957, 1968, and 1973 aerial photos (Figure D-16). He describes the 1877 to 1940 period of data as one which documents the long-term natural recession rate for the Maumee Bay shoreline as it is prior to construction of most of the private shore protection works. He also describes the comparison of 1957 to 1968 and 1968 to 1973 as allowing an excellent opportunity to analyze the effects of a low lake level period with a high lake level period, respectively.

Benson's Reach 4 extends from Norton Road to Cedar Point with Segments 109 through 112 of this reach proposed for a recreational beach, and Segments 113 through 127 to be protected by a revetment. Table D-7 summarizes his results. Segments 109 through 112 exhibit one of the most rapidly receeding shores on Lake Erie having a weighted average erosion rate of 12.9 feet/year, from 1877 to 1973 and an extreme erosion rate of 30.0 feet/year during the high lake level period of 1968 to 1973. A number of other observations can be made from Table D-7. For example, recession rates were generally higher during the high water period of 1968 to 1973 than during the lower water period of 1957 to 1968. The Niles Beach area (Segments 113 to 117) is protected by a poor quality scrap material revetment. Even this poor level of protection has had a dramatic effect in reducing the local recession rate. Conversely, construction of an earthen dike at Cedar Point has reduced the accretion along this reach. The shoreline for Segments 109 through 112 has receded a maximum of 1,340 feet since 1877. In 1877, the tip of Cedar Point was located 2,500 feet northeast of the present location of Segment 139. By 1940 it had migrated to the southwest and was located approximately 3,500 feet directly west.

Four shoreline type areas (clay plains, barrier beach, wetlands, and artificially protected) have existed at the east end of Maumee Bay through the period of this recession analysis. Each type of shoreline reacts differently to the physical processes of erosion and exhibits differing recession rates. Rose (1978, Ref. 8) determined that the Maumee Bay-Cedar Point shoreline has adjusted to the equilibrium beach shape of a logarithmic spiral (Figure D-17). Log spiral shaped bays have been interpreted in the technical literature as signifying that net longshore drift has ceased and incoming wave trains generally refract until they break parallel to the shore at all points along the spiral. A cursory examination of the Maumee Bay-Cedar Point shoreline since 1877 suggests that as lake level has risen and Cedar Point (the headland which fixes the spiral) has moved to the west, that the shoreline has shifted inland along a rotating log spiral. Thus, local erosion at the western end of the log spiral is quite dramatic as the shoreline approaches equilibrium relative to the migratory Cedar Point position.

e. Sediment Budget.

Benson (1975) has developed a general sediment budget for Maumee Bay (Figure D-18). The material which enters the bay via the rivers, shore erosion, or from Lake Erie are normally silts and clays which are carried in suspension. The material which enters the bay from North Cape and Cedar Point is generally sand or gravel which is transported by saltation or as bed load. This material usually deposits in restricted shoals and bars. The total computed contribution of material into the bay is 1,068,000 tons per

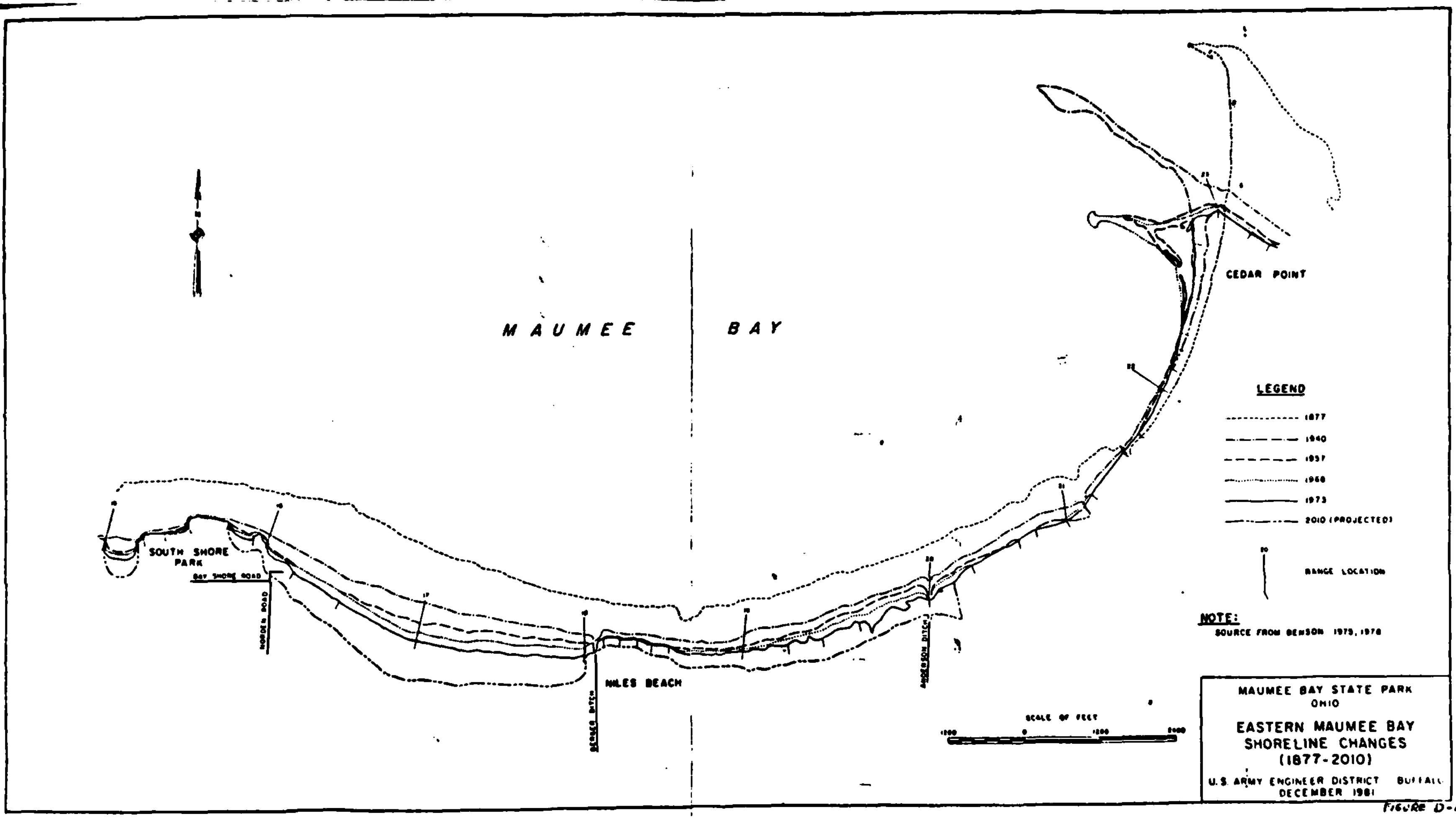

MAUMEE BAY
CEDAR POINT
SOUTH SHORE PARK
BAY SHORE ROAD
NORDEN ROAD
NILES BEACH
BERGER DITCH
ANDERSON DITCH
LEGEND
1877
1940
1957
1968
1973
2010 (PROJECTED)
RANGE LOCATION
NOTE:
SOURCE FROM BENSON 1975, 1976
SCALE OF FEET
1200 0 1200 2400
MAUMEE BAY STATE PARK
OHIO
EASTERN MAUMEE BAY
SHORELINE CHANGES
(1877-2010)
U.S. ARMY ENGINEER DISTRICT BUFFALO
DECEMBER 1981
FIGURE D-16

Table D7 - Western Maumee Bay, Reach 4 Recession Rates
(foot/year) (Benson, 1975)

Location	Segment	Length (feet)	1877-1940 (±0.15 feet)	1940-1957 (±0.6 feet)	1957-1968 (±0.9 feet)	1968-1973 (±2.0 feet)	1877-1973 (±0.1 feet)
Norton Ditch	109	600	E (12.7)	R (5.9)	S (1.8)	E (12.0)	E (11.1)
	110	800	E (15.1)	E (12.9)	—	E (26.0)	E (13.5)
	111	1,300	E (14.3)	E (11.2)	E (12.7)	E (22.0)	E (14.0)
	112	2,600	E (10.8)	E (13.5)	E (13.6)	E (30.0)	E (12.6)
Berger Ditch	113	300	VR (7.6)	VR (7.1)	—	—	R (6.3)
Niles Beach	114	250	R (6.8)	S (2.9)	S (1.8)	—	R (5.2)
	115	300	R (6.8)	M (3.5)	—	M (4.0)	R (5.3)
	116	250	R (6.8)	R (5.3)	S (2.7)	—	R (5.7)
	117	250	VR (7.8)	M (4.7)	—	M (4.0)	R (6.1)
	118	1,200	VR (8.6)	R (5.9)	S (2.7)	VR (8.0)	VR (7.4)
	119	750	R (6.8)	E (11.2)	R (6.4)	E (10.0)	VR (7.7)
	120	550	VR (7.9)	VR (7.6)	M (4.5)	E (22.0)	VR (8.2)
	121	600	VR (7.9)	R (5.9)	VR (7.3)	E (24.0)	VR (8.3)
	122	1,100	R (6.8)	M (4.7)	VR (8.2)	E (24.0)	VR (7.5)
Anderson Ditch	123	900	R (6.7)	R (5.9)	M (3.6)	E (18.0)	R (6.8)
	124	800	R (5.1)	VR (8.2)	M (3.6)	—	R (5.2)
	125	150	R (5.4)	E (9.4)	—	—	R (5.2)
	126	450	VR (7.1)	VR (8.2)	M (4.5)	—	R (6.7)
	127	600	R (6.3)	M (4.7)	—	E (10.0)	R (5.5)
Cedar Point	128	800	M (4.0)	M (4.7)	—	—	M (3.4)
	129	350	Acc	S (2.4)	—	—	Acc
	130	800	Acc	S (2.4)	M (4.5)	—	Acc
	131	400	Acc	S (1.2)	M (3.6)	—	Acc
	132	350	Acc	Acc	M (4.5)	—	Acc
	133	200	Acc	Acc	S (1.8)	—	Acc
	134	550	Acc	Acc	—	—	Acc
	135	350	Acc	—	—	—	Acc
	136	450	Acc	Acc	—	—	Acc
	137	250	Acc	Acc	—	—	Acc
	138	100	Acc	Acc	—	—	Acc
	139	400	Acc	E (14.7)	R (6.4)	L (18.0)	Acc
		18,850					

E = Extreme
VR = Very Rapid
R = Rapid
M = Moderate
S = Slow
VS = Very Slow
ACC = Accretion
Dashes = No Measurable Change

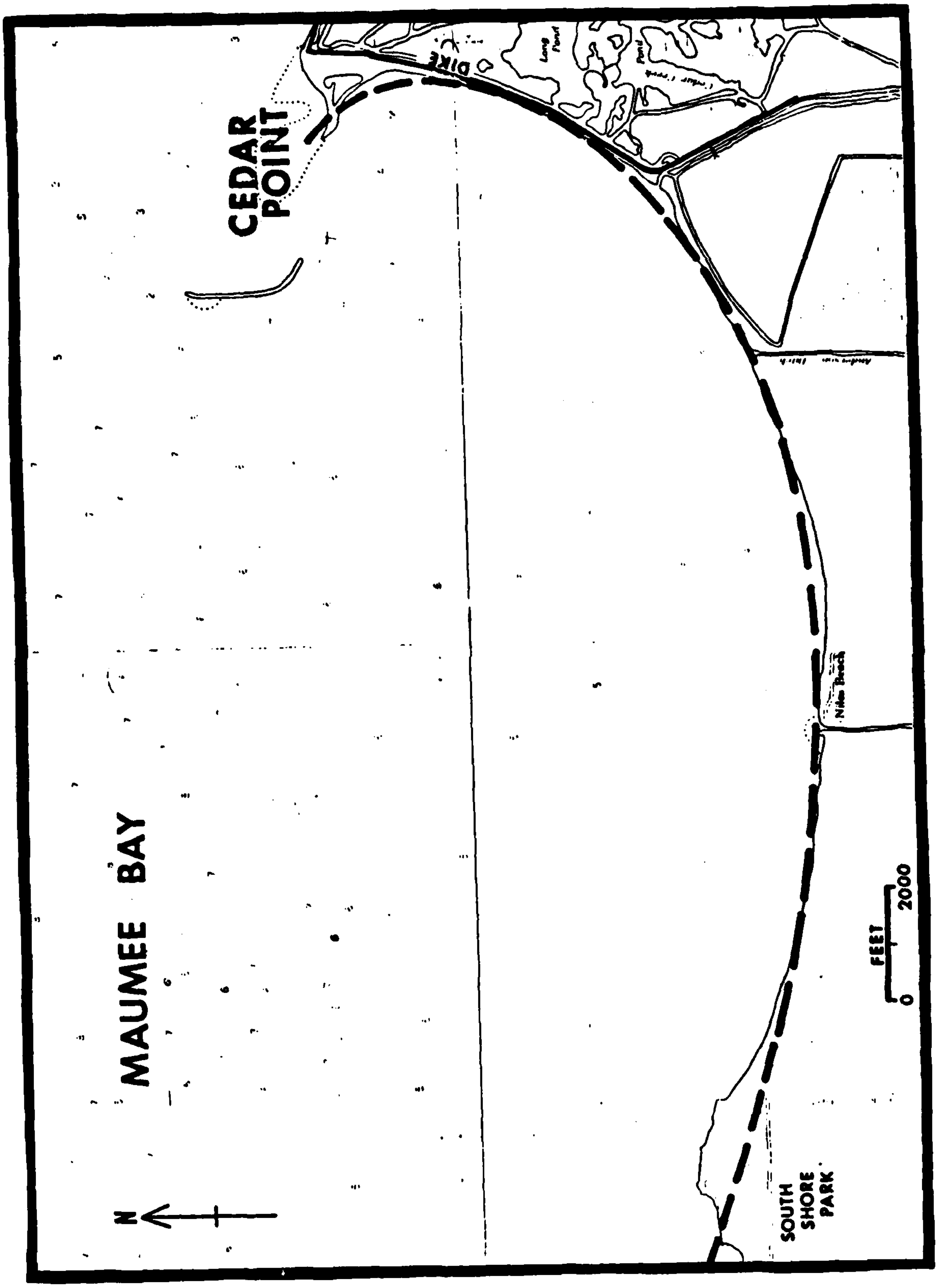


Figure D-17 - Fitted Logarithmic Spiral Curve for Cedar Point Shoreline (d = 44^{o}) (Rose, 1978)

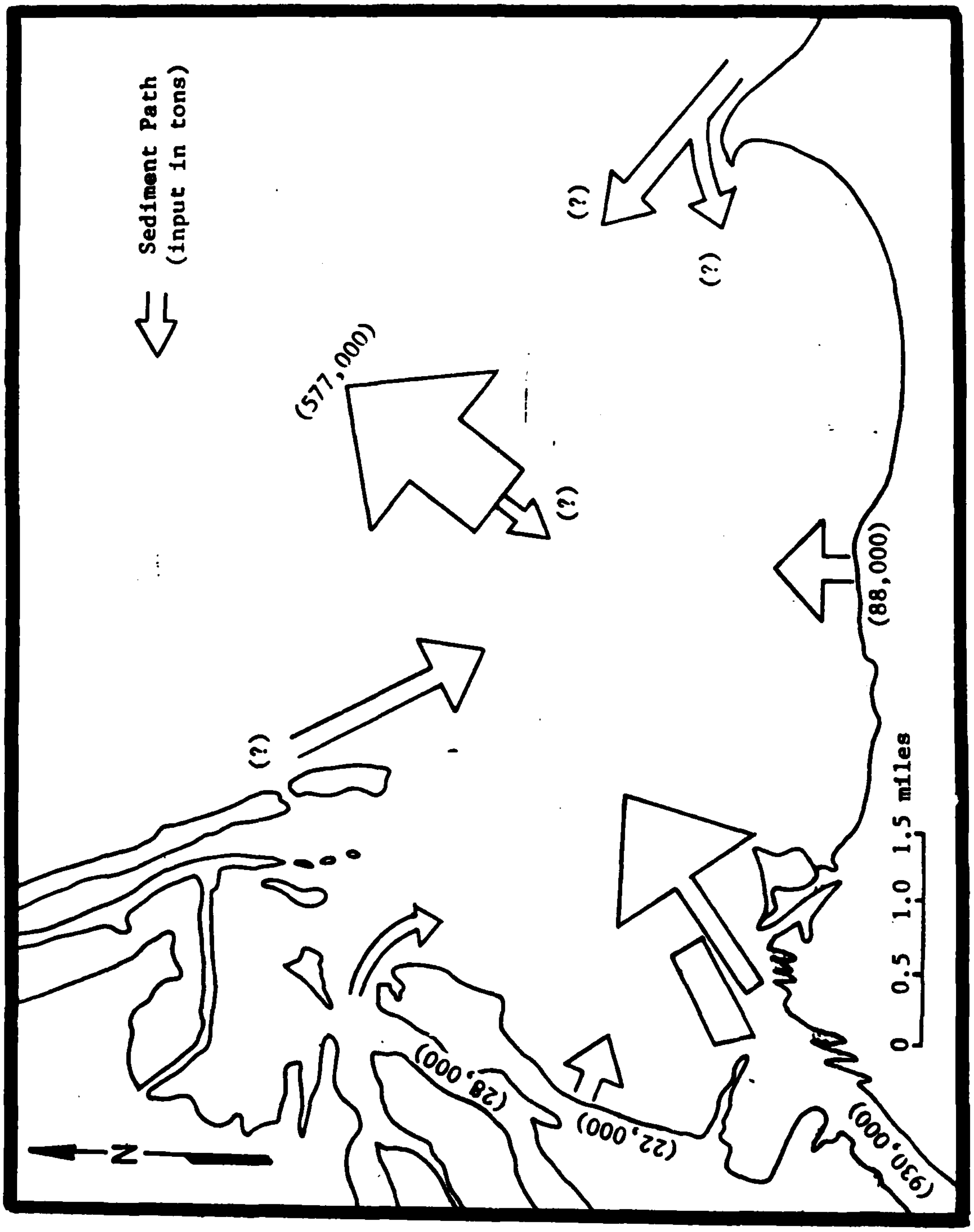


Figure D-18 - Maumee Bay Sediment Budget (Benson, 1975)

year. Based on historical bathymetric data from the bay, Benson determined that 410,000 tons of this material accumulates annually in the dredged navigation channel and 81,000 tons collects in the rest of the bay. Thus, a total of 491,000 tons collects in the bay annually and, therefore, some 577,000 tons probably enters the open lake. But this budget of suspended silts and clays does not provide much insight into the quantities of sand loss and gain to be anticipated at Maumee Bay State Park. In fact, the mediocre sand supply in this area and the lack of wave energy data prohibits development of a reasonable sand sediment budget, either real or predicted.

However, for the Maumee Bay State Park site some qualitative assumptions can be made regarding the proposed alternative plans. The recession rates presented in the previous section have been recalculated to determine the subaerial volume of sediment annually lost to the lake for Segments 109 through 112. In addition, the subaqueous erosion rates were compared to arrive at a total erosion volume per segment (Table D-8). From Table D-8, it is estimated that the presently unprotected reach from Norton Ditch to Berger Ditch contributes 20,000 cubic yards of eroded sediments annually due to shore recession and offshore erosion. These are silts and clays which are unsuitable as beach material and are transported offshore as a suspended material. Upon placement of a sand beach in this area the quantity of average annual loss is actually expected to be less. A sloped medium sand beach will be less erodable than the noncohesive disintegrating, granular clay which presently makes up this shore. Although the proposed sand beach will, in effect, be a positive feature along the shore and, therefore, more directly subject to the energy of the incoming waves, the shallowness of the offshore and the local tendancy for little net drift dominance could result in a stable beach face which changes quite slowly. There should be some alongshore sand losses to the west and offshore losses should only become a factor during times of extreme storm activity when the local wave climate can build to heights capable of eroding and transporting sand.

Table D8 - Calculating Sediment Loss from Maumee Bay State Park Shore Erosion

Segment	Length (feet)	Total Erosion* (yd^3/ft/yr)	Total Volume (Yd^3/yr)
109	600	3.3	1,980
110	800	4.5	3,600
111	1,300	4.2	5,460
112	2,600	3.3	8,580
Total			19,620 (say 20,000)

* From Benson, 1975.

Based on the previously developed logic, the estimate of 20,000 cubic yards average annual offshore loss for an unprotected sand beach (Alternative 2a) is viewed as a probable upper limit. In addition, 25,000 cubic yards of sand or more may need to be backpassed annually. Assuming a 75 percent effectiveness for offshore breakwaters in reducing sediment transport, the anticipated annual sand loss for Alternative 3a and 3b becomes 5,000 cubic yards per year. The need for sand backpassing will probably be negligible with the breakwater alternative.

f. Littoral Tests.

A line of reasoning suggests that an unprotected sand beach (as Alternative 2a) may have smaller nourishment rates than that protected which may make this alternative a more favorable plan.

As an aid in understanding littoral processes and to better document the above mentioned nourishment and backpassing quantities, two different types of littoral tests were initiated. The first of the tests was in the form of Littoral Environment Observations (LEO) which are observations made at two specified sites along the study area to document wave, wind, beach, and current information. The data that is collected is reduced and analyzed to give a comprehensive summary of littoral conditions.

The second test is a sand tracer test which involved the placement of a fixed quantity of sand into the littoral zone and a study of its behavior. By monitoring the movement of the sand which is exposed to open-lake conditions, the movement of an unprotected sand beach should be better understood.

LEO data was collected on a daily basis during the period April through December 1981 at two locations along the shoreline of the park. The first location was identified as Site Number 41011-Maumee State Park, located approximately 1,000 feet east of Norden Road and the second site was identified as Site Number 41012-Niles Beach, located approximately 1,000 feet east of Curtice Road. The results are included as Supplement 1 at the back of this Appendix (D). Basic findings of the summary data are somewhat inconclusive due to some erroneous data that was collected during the month of October, however, the remainder of the data appears accurate. The reported transport rates are therefore inaccurate and considerably higher than actual. Exclusive of the October data littoral conditions at the two sites were very similar and showed only a slight predominant east to west direction of littoral transport. Wave conditions at the site were most severe during the spring and fall, but were generally mild and did not exceed 3.0 feet in height or 3.5 seconds in period during the testing program. No major damaging storm events occurred from the north or northeast direction, however, several times southwest winds caused a substantial setdown in lake level.

The sand tracer test was initiated in October of 1981 in which approximately 50 yds^3 of a tracer sand was placed in the littoral zone in a groin like configuration. A monitoring plan consisting of surveys and sampling was established and performed by the State of Ohio, Division of Geological Survey, with an Open File Report 82-1 being submitted to the District in

August of 1982. The report is included as Supplement 2 to this Appendix (D). Basic findings of the report are that all of the sand moved to the beach within 1 month of placement along with reasonably rapid movement of sand to the west. Only small amounts of placed sand were detected to move east. The following spring, a near record storm pushed all of the shoreface sand onshore and into the marsh, removing it from the survey area. The report suggests that there was little if any lakeward movement.

Even though considerable information was learned from this test it is difficult to draw conclusive results. Since there was not an elevated back beach area in the test as would be in the completed project, it cannot be predicted whether the sand that washed onshore might actually have moved offshore due to backrush. This possibility can only be answered by performing a full scale test which is beyond the scope of this level of study. However, the pronounced longshore or westerly movement that was found is believed to have been accurately modeled and should be representative of what would be expected in the completed project.

In summary, it was found the two tests showed somewhat different results. The LEO tests indicated very little westward transport while the tracer sand test indicated significant westward and onshore transport. However, only the sand test was exposed to a major storm event during the spring of this year. Due to these contradictions and variables and to the uncertainties associated with each test, the reliability of the results as a basis for refining the predicted rates is not possible. The test results, in general, support the current predicted nourishment rate of 20,000 yds^3/yr, and backpassing rate of 25,000 yds^3/yr for Alternative 2a, and provide no justification for change. For this stage of study it is believed these rates are well supported in terms of providing for a stable and sound beach as would be provided by Alternative 2a.

D5. INCREMENTAL BEACH ANALYSIS FOR SELECTION OF THE OPTIMUM BEACH CONFIGURATION

In response to BERH (Board of Engineers for Rivers and Harbors) comments, dated 25 October 1983, and comments received during a project field visit on 31 October-1 November 1983, an incremental beach design analysis was performed. The analysis is necessary to show that the costs associated with an array of possible beach widths and lengths result in a project that is incrementally optimized. Six beach widths were, therefore, analyzed ranging from 100 feet to 250 feet in combination with four beach lengths which were set at 2,500 feet, 3,000 feet, 4,000 feet, and 5,500 feet.

The beach designs presented in Section D3 of this Appendix were included as part of the analysis but have been modified slightly to provide more uniformity in the various beach cross-sections that were analyzed. This included slight changes in beach locations and slopes plus the deletion of the grassy area for Alternative 3b. The beach configurations that were analyzed are shown in Figures D-19 and D-20 for the new Alternative 2b and 3c beach plans. As can be seen, the primary features of all the plans include beach widths that range from 100 feet to 250 feet extending from approximately elevation 0 LWD to elevation +10 LWD and terminated on the landward side by a vegetated

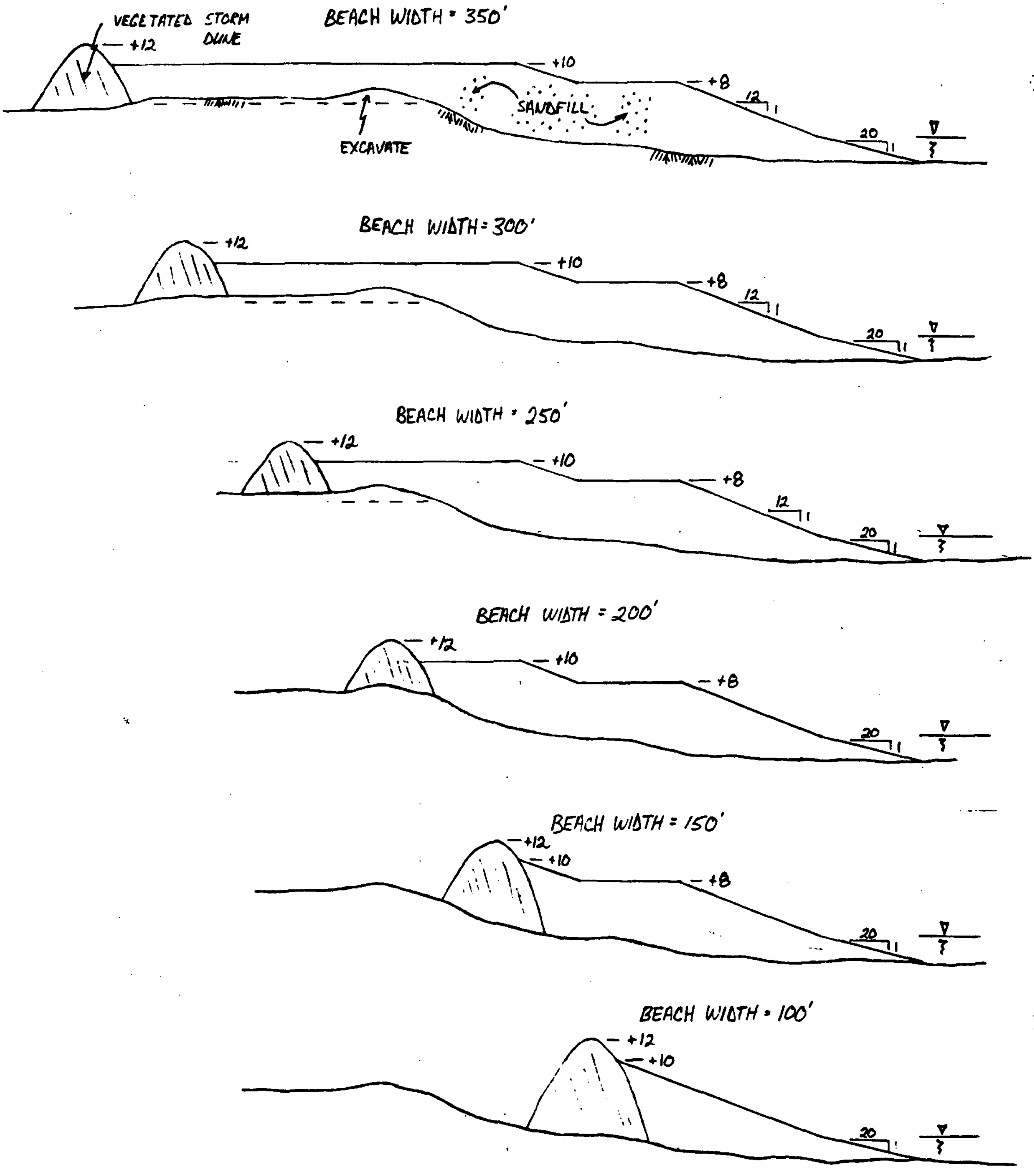


FIG. D-19 - ALTERNATIVE 2b BEACH CONFIGURATIONS

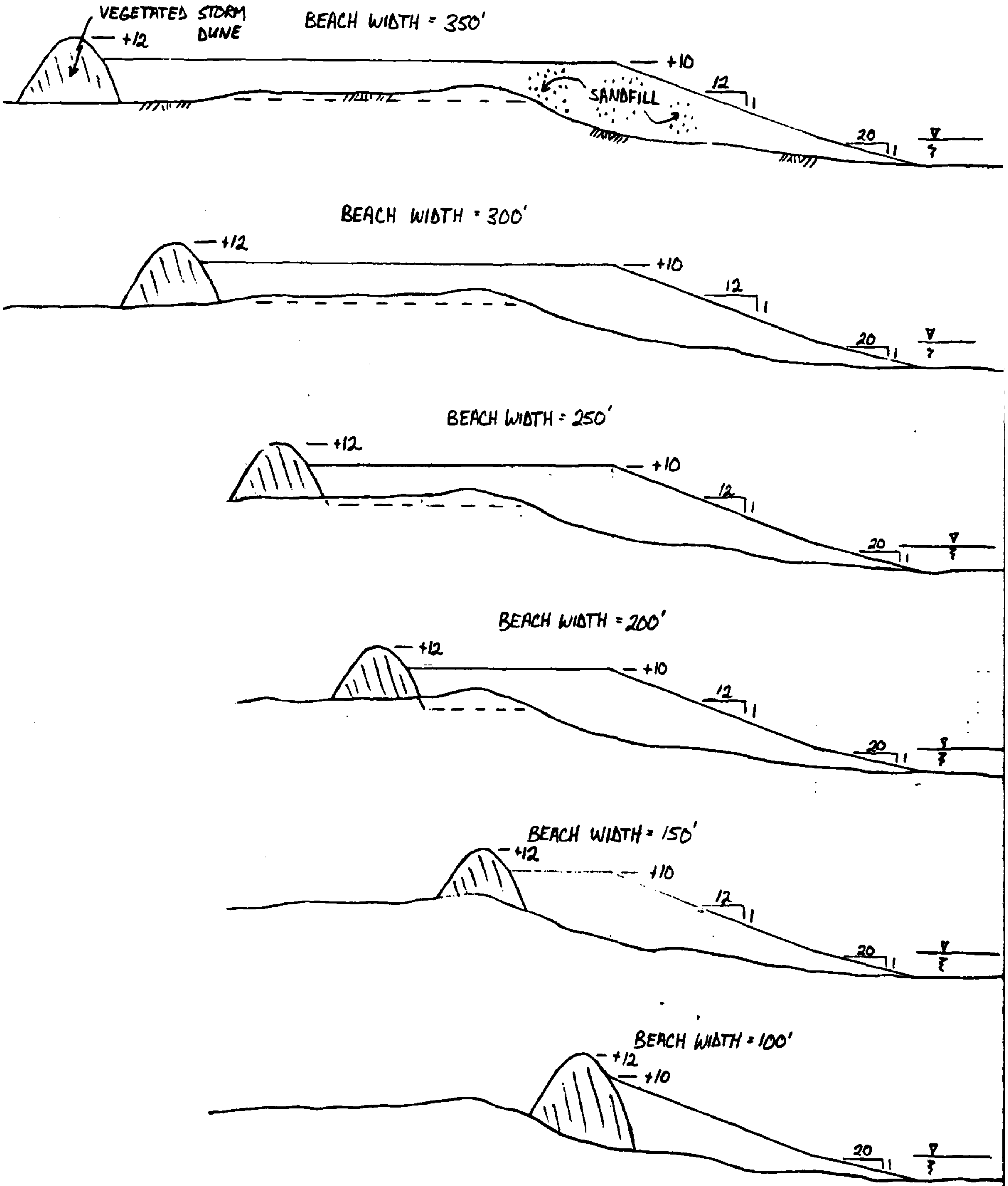


FIG. D-20 - ALTERNATIVE 3c BEACH CONFIGURATIONS

storm dune. The storm dune is believed to be the most cost effective way of retaining the beachfill and preventing overwash.

The primary difference between the Alternative 2b and 3c beach plans is that the 3c plans are recessed further into the shoreline. This results in a smaller sandfill requirement for the 3c plans but also means less sand cover and hence less protection to the existing shore. This is possible due to the added protection that will be provided by the offshore breakwaters which are also part of Alternative 3c. The other primary difference is the two berm configuration that is only shown for the Alternative 2b plans. The two berm configuration results in a stable beach design that minimizes the quantity of sandfill without significantly decreasing the protection it affords to the existing shoreline.

Further beach design information that was used for the original beach designs and for the above mentioned array of beach plans is provided in Section D3 of this Appendix and in the supplement report attached as Appendix K. The supplement report also contains information on initial sandfill quantities, beach slopes and elevations, and rationale for nourishment and backpassing rates that are also provided.

This information was provided as input for economic evaluation to be used in the selection of the optimal beach configuration. The economic analysis is also provided in the supplemental report of Appendix K which determined the Alternative 3c beach plan (250' wide by 5,500' long) to be the selected plan. A cross-section of this beach plan is shown on Plate D-12.

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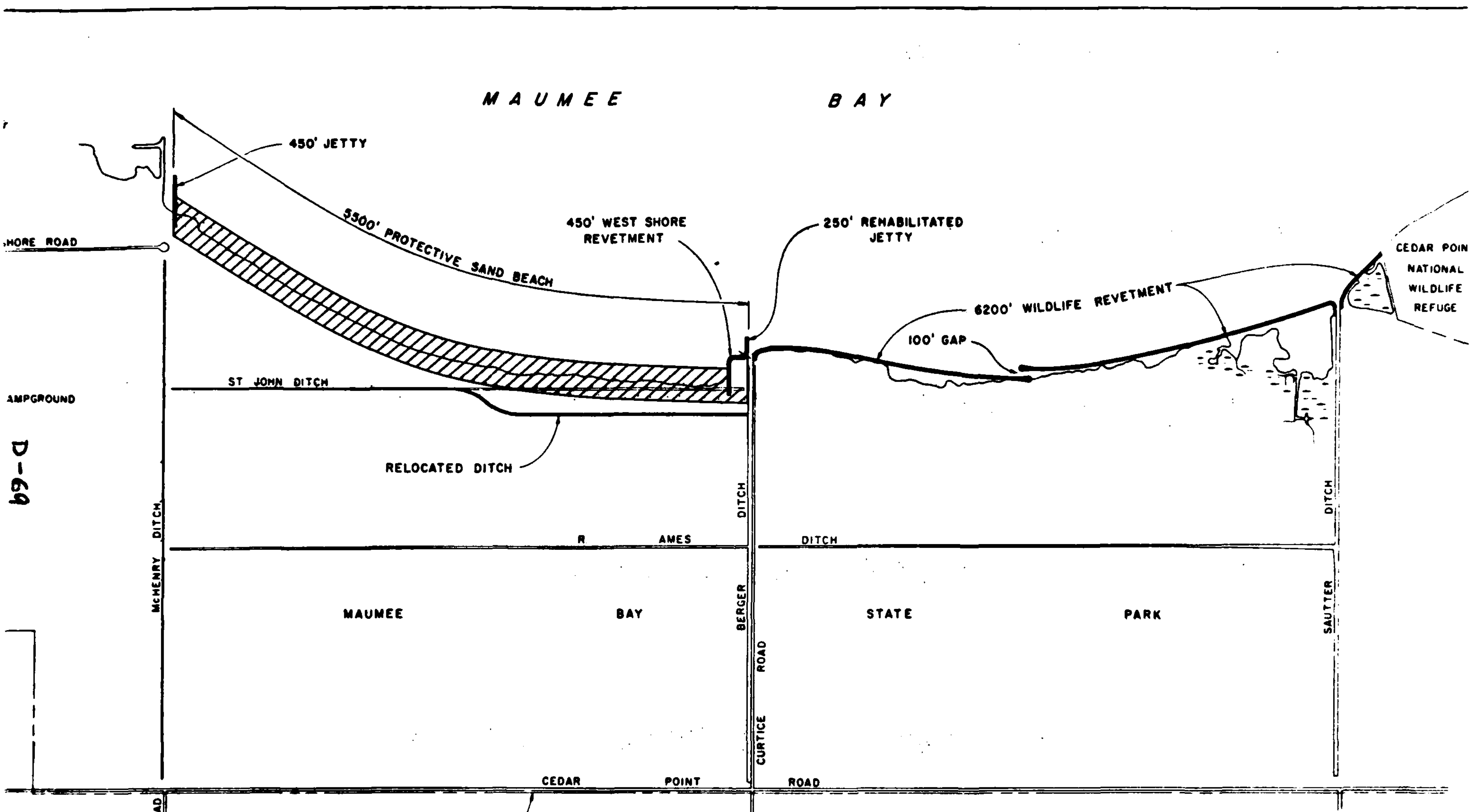
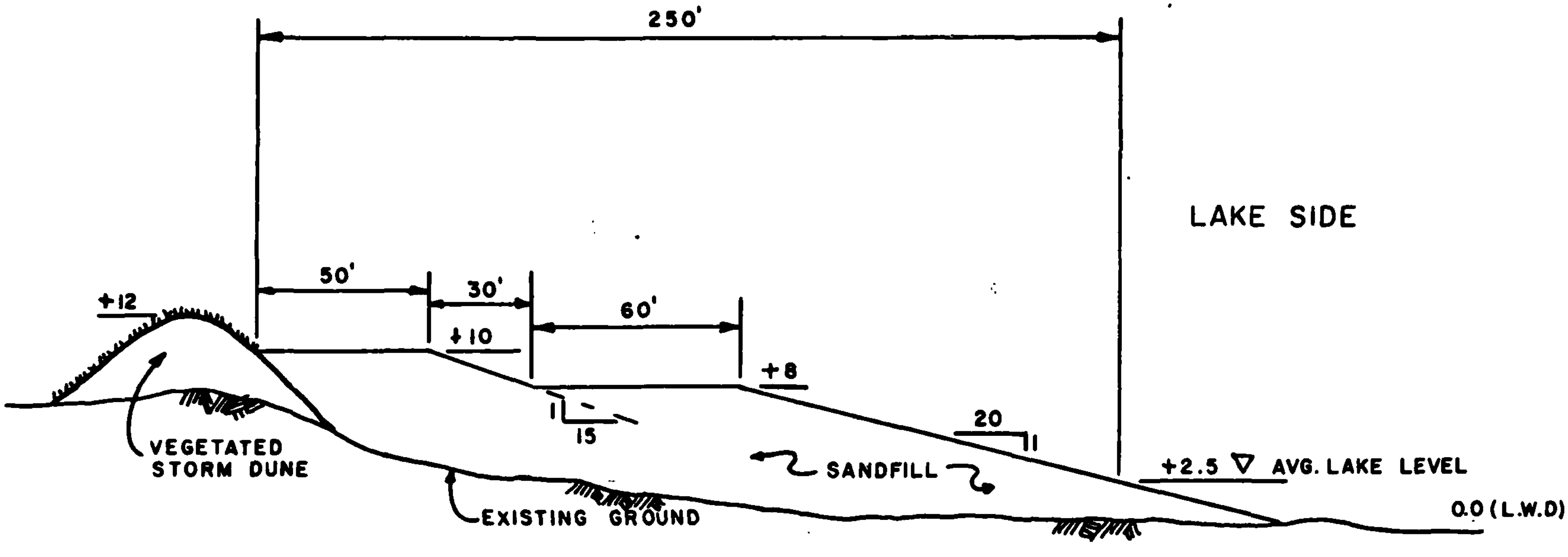


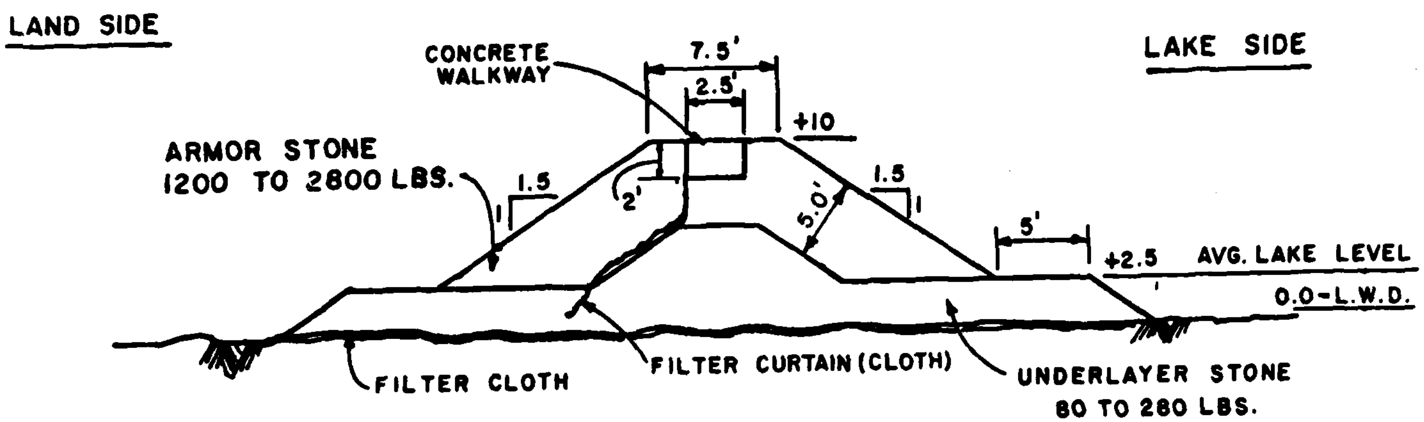
MAUMEE BAY STATE PARK
OHIO
ALTERNATIVE 2a
PROTECTIVE SAND BEACH & REVETMENTS
U S. ARMY ENGINEER DISTRICT BUFFALO
JULY 1981



TYPICAL BEACH CROSS-SECTION - ALTERNATIVE 2a

SCALE HORIZ. 1" = 50'
VERT. 1" = 10'

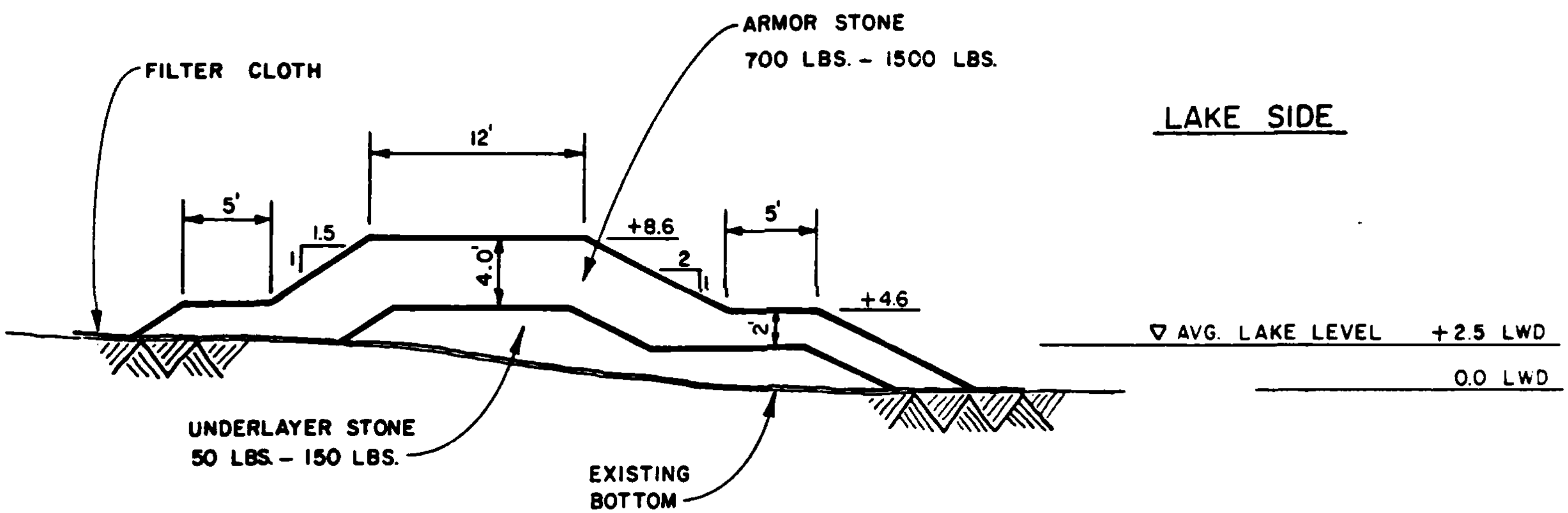
MAUMEE BAY STATE PARK, OHIO
ALTERNATIVE 2a
TYPICAL SAND BEACH SECTION
U.S. ARMY ENGINEER DISTRICT BUFFALO
JULY 1981



TYPICAL JETTY CROSS SECTION

SCALE 1" = 10'

MAUMEE BAY STATE PARK, OHIO
TYPICAL JETTY SECTION
U.S. ARMY ENGINEER DISTRICT BUFFALO
JULY 1981



TYPICAL WILDLIFE REVETMENT CROSS SECTION

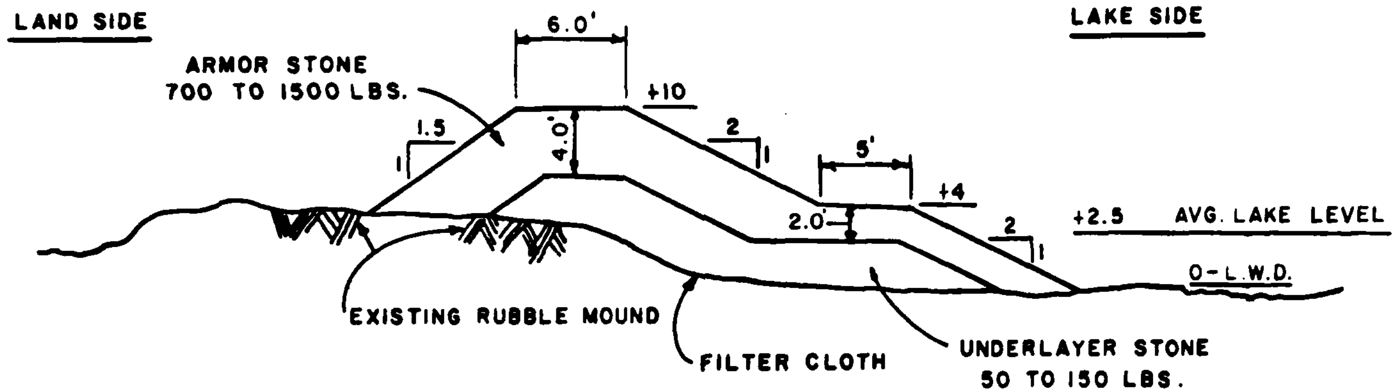
SCALE 1" = 10'

MAUMEE BAY STATE PARK, OHIO

TYPICAL WILDLIFE REVETMENT SECTION

U.S. ARMY ENGINEER DISTRICT BUFFALO

JULY 1981



TYPICAL REVETMENT SECTION AT BERGER DITCH

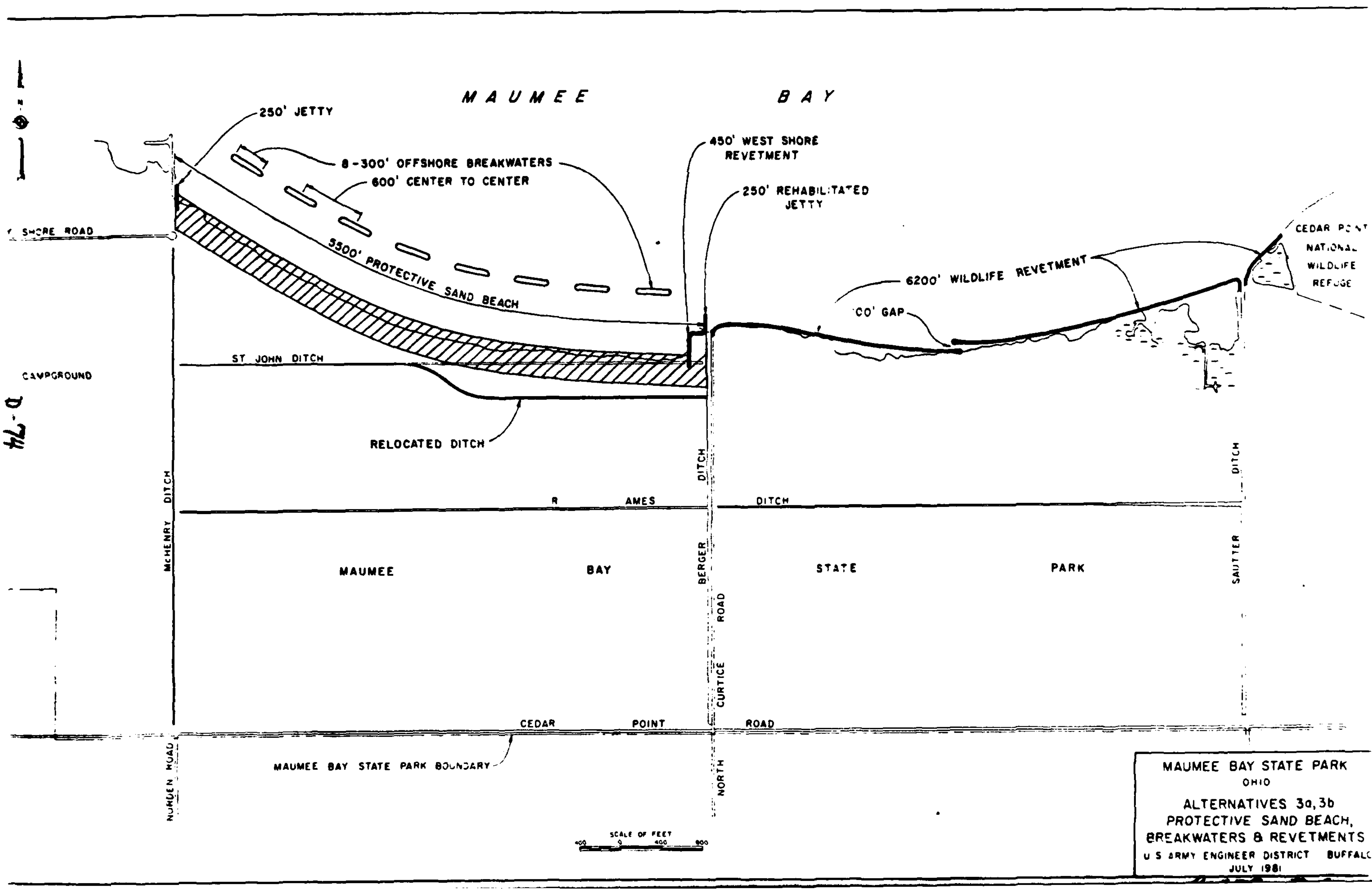
SCALE 1" = 10'

MAUMEE BAY STATE PARK, OHIO

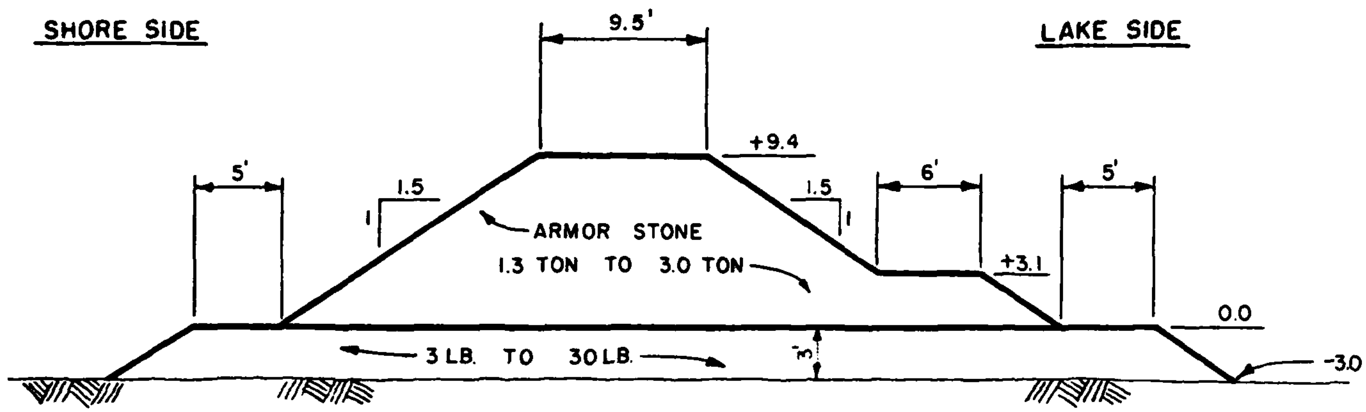
TYPICAL REVETMENT SECTION
AT BERGER DITCH

U.S. ARMY ENGINEER DISTRICT BUFFALO

JULY 1981



MAUMEE BAY STATE PARK
OHIO
ALTERNATIVES 3a, 3b
PROTECTIVE SAND BEACH,
BREAKWATERS & REVETMENTS
U S ARMY ENGINEER DISTRICT BUFFALO
JULY 1981



TYPICAL OFFSHORE BREAKWATER CROSS SECTION

SCALE 1" = 10'

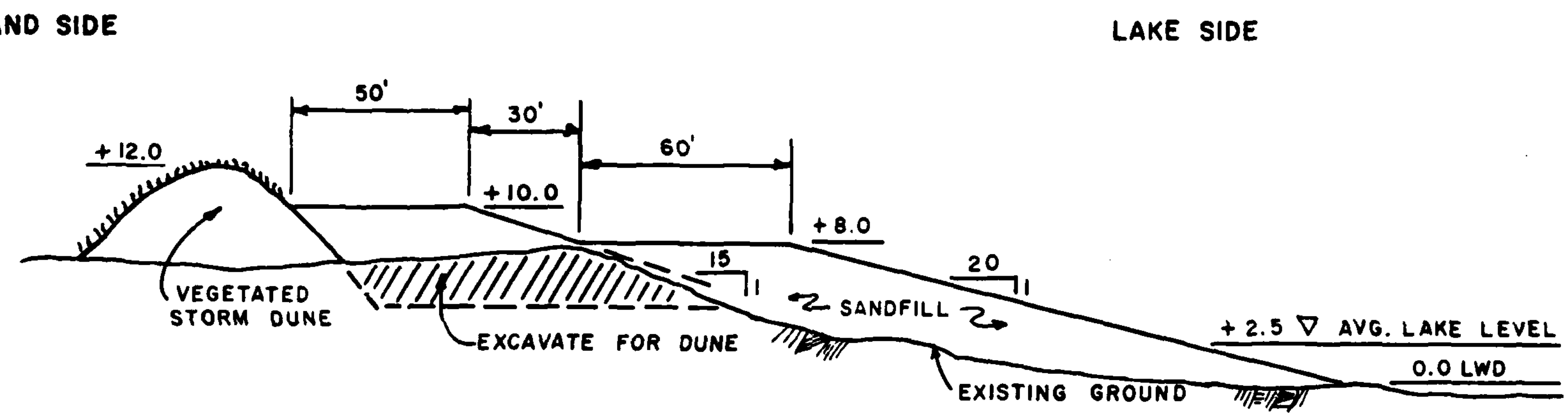
MAUMEE BAY STATE PARK, OHIO

TYPICAL OFFSHORE

BREAKWATER SECTION

U.S. ARMY ENGINEER DISTRICT BUFFALO

JULY 1981



TYPICAL SAND BEACH SECTION–ALTERNATIVE 3a

SCALE HORIZ. 1" = 50'
VERT. 1" = 10'

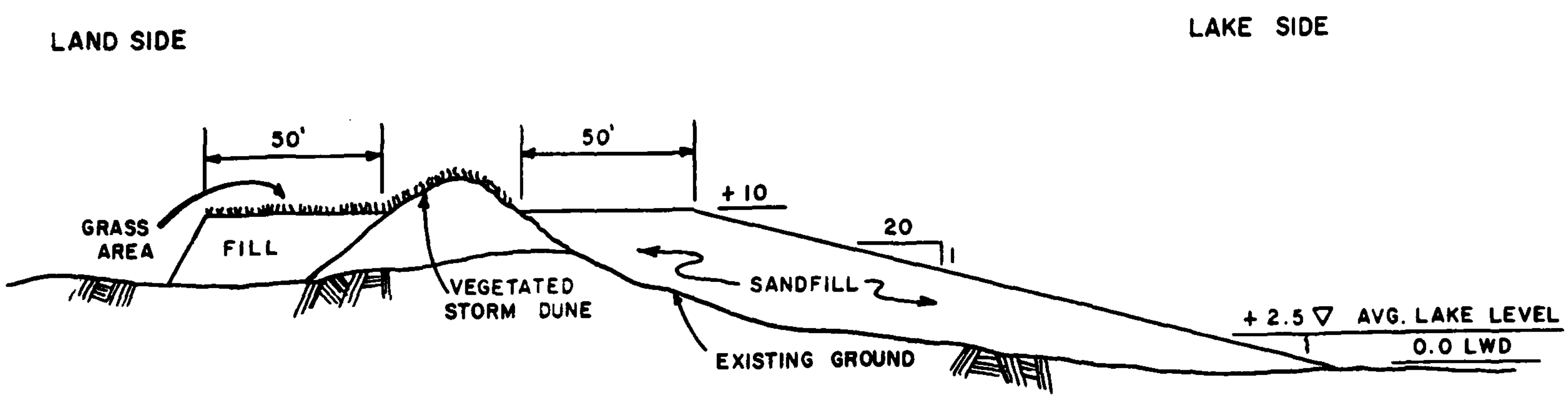
MAUMEE BAY STATE PARK, OHIO

ALTERNATIVE 3a
TYPICAL SAND BEACH SECTION

U.S. ARMY ENGINEER DISTRICT BUFFALO

JULY 1981

PLATE D-8

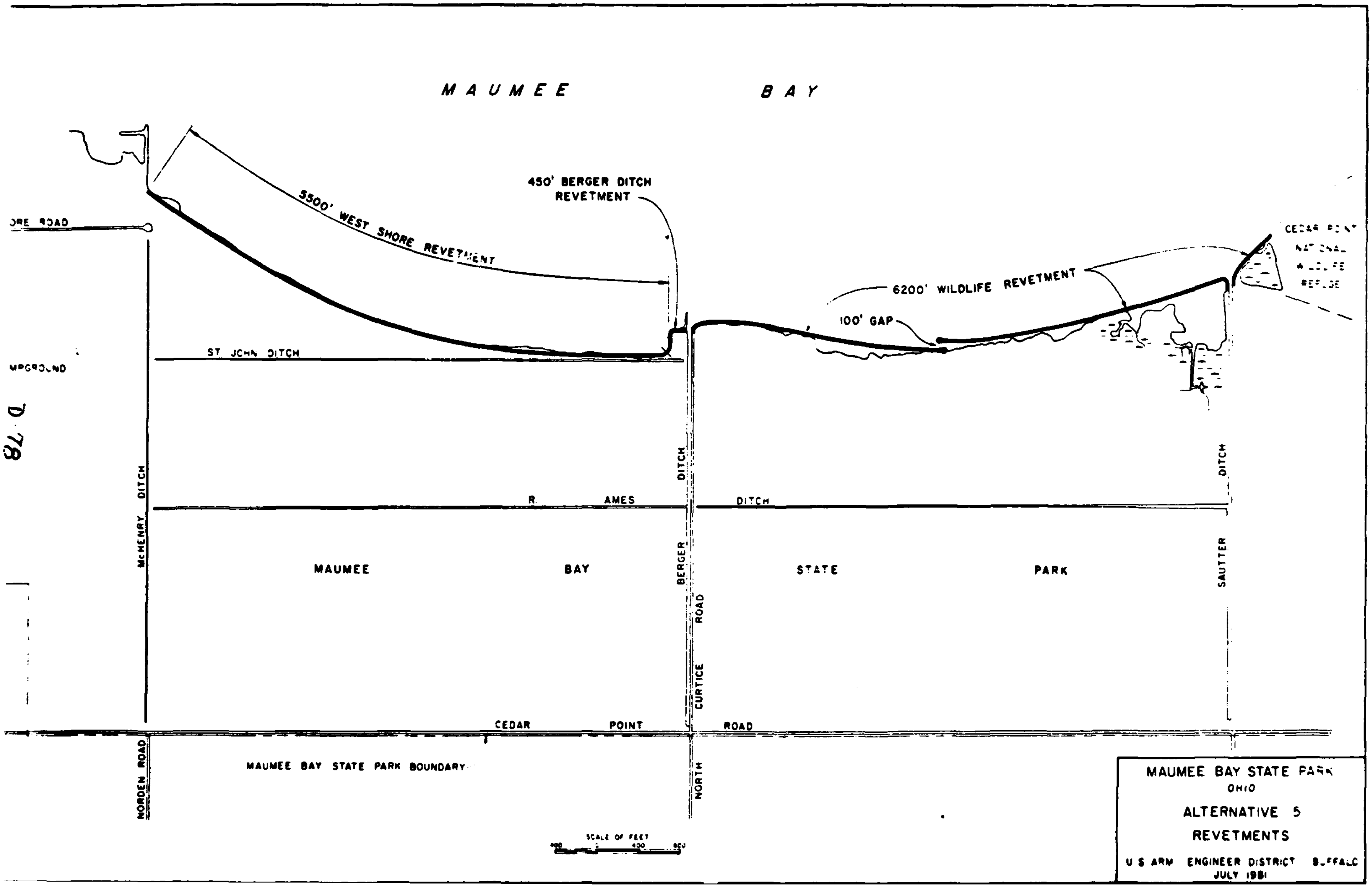


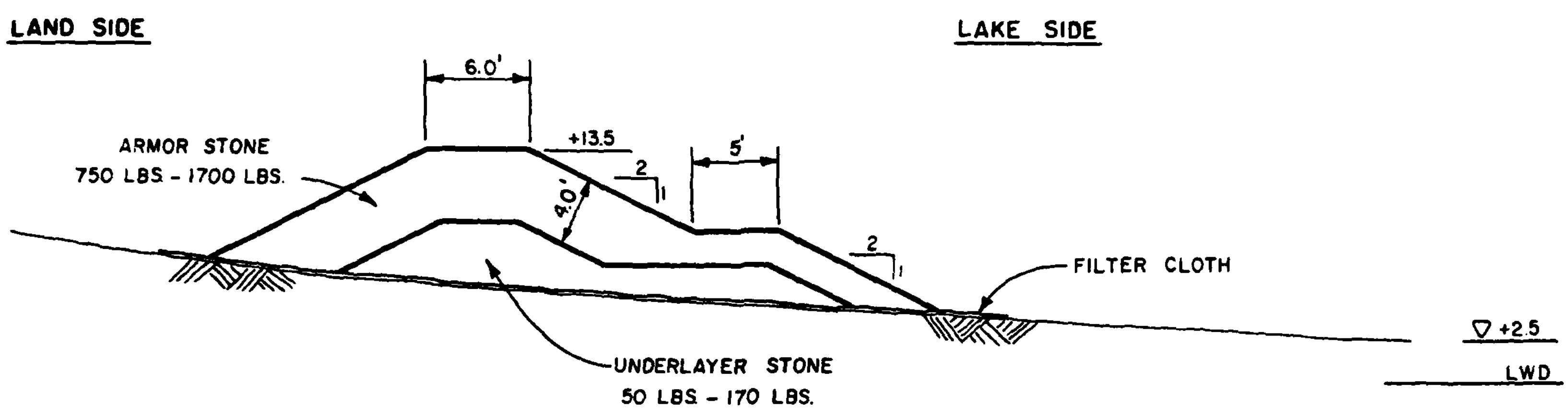
TYPICAL SAND AND TURF SECTION—ALTERNATIVE 3b

SCALE HORIZ. 1" = 50'
VERT. 1" = 10'

MAUMEE BAY STATE PARK, OHIO
ALTERNATIVE 3b
TYPICAL SAND AND TURF
BEACH SECTION
U.S. ARMY ENGINEER DISTRICT BUFFALO
JULY 1981

PLATE D-4


MAUMEE BAY
5500' WEST SHORE REVETMENT
450' BERGER DITCH REVETMENT
6200' WILDLIFE REVETMENT
100' GAP
CEDAR POINT NATIONAL WILDLIFE REFUGE
ST JOHN DITCH
R. AMES DITCH
McHENRY DITCH
BERGER DITCH
SAUTTER DITCH
CURTICE ROAD
NORTH ROAD
NORDEN ROAD
CEDAR POINT ROAD
MAUMEE BAY STATE PARK
MAUMEE BAY STATE PARK BOUNDARY
SCALE OF FEET
400 0 400 800
MAUMEE BAY STATE PARK
OHIO
ALTERNATIVE 5
REVETMENTS
U S ARMY ENGINEER DISTRICT BUFFALO
JULY 1981



WEST SHORE BEACH REVETMENT

SCALE 1" = 10'

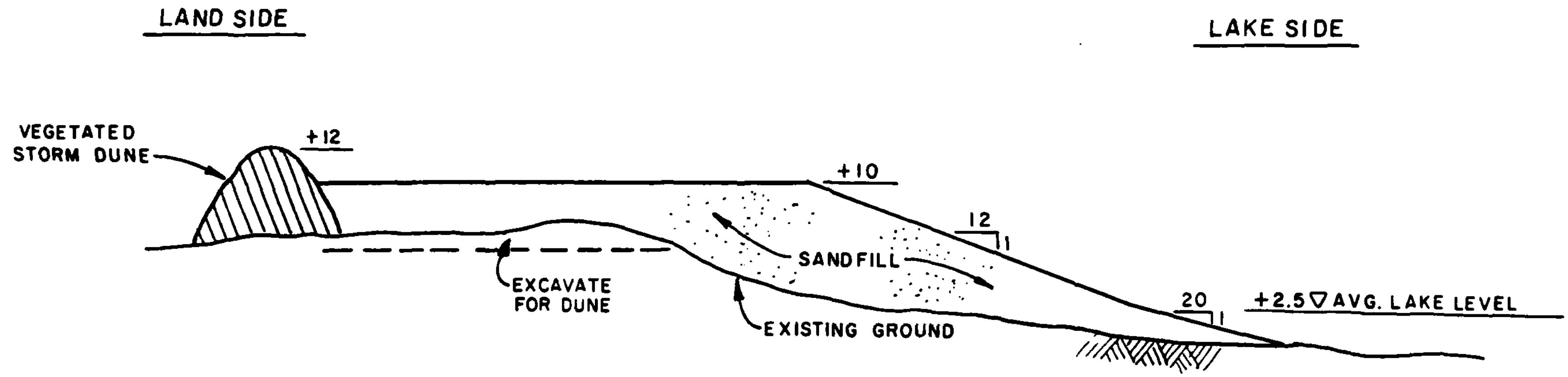
MAUMEE BAY STATE PARK, OHIO

TYPICAL REVETMENT SECTION

WEST BEACH

U.S. ARMY ENGINEER DISTRICT BUFFALO

JULY 1981



TYPICAL SAND BEACH SECTION – ALTERNATIVE 3C
SELECTED PLAN

SCALE: HORIZ 1" = 50'
VERT. 1" = 10'

MAUMEE BAY STATE PARK, OHIO
ALTERNATIVE 3C
TYPICAL SAND BEACH SECTION
U.S. ARMY ENGINEER DISTRICT BUFFALO

PLATE D-12

SUPPLEMENT 1
COASTAL ENGINEERING RESEARCH CENTER (CERC)
APPENDIX D

ANALYSIS OF LITTORAL ENVIRONMENT OBSERVATIONS (LEO) DATA

MAUMEE BAY STATE PARK, OH

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207
September 1982

SITE 41011

POTENTIAL LONGSHORE TRANSPORT VERSUS TIME - 1981

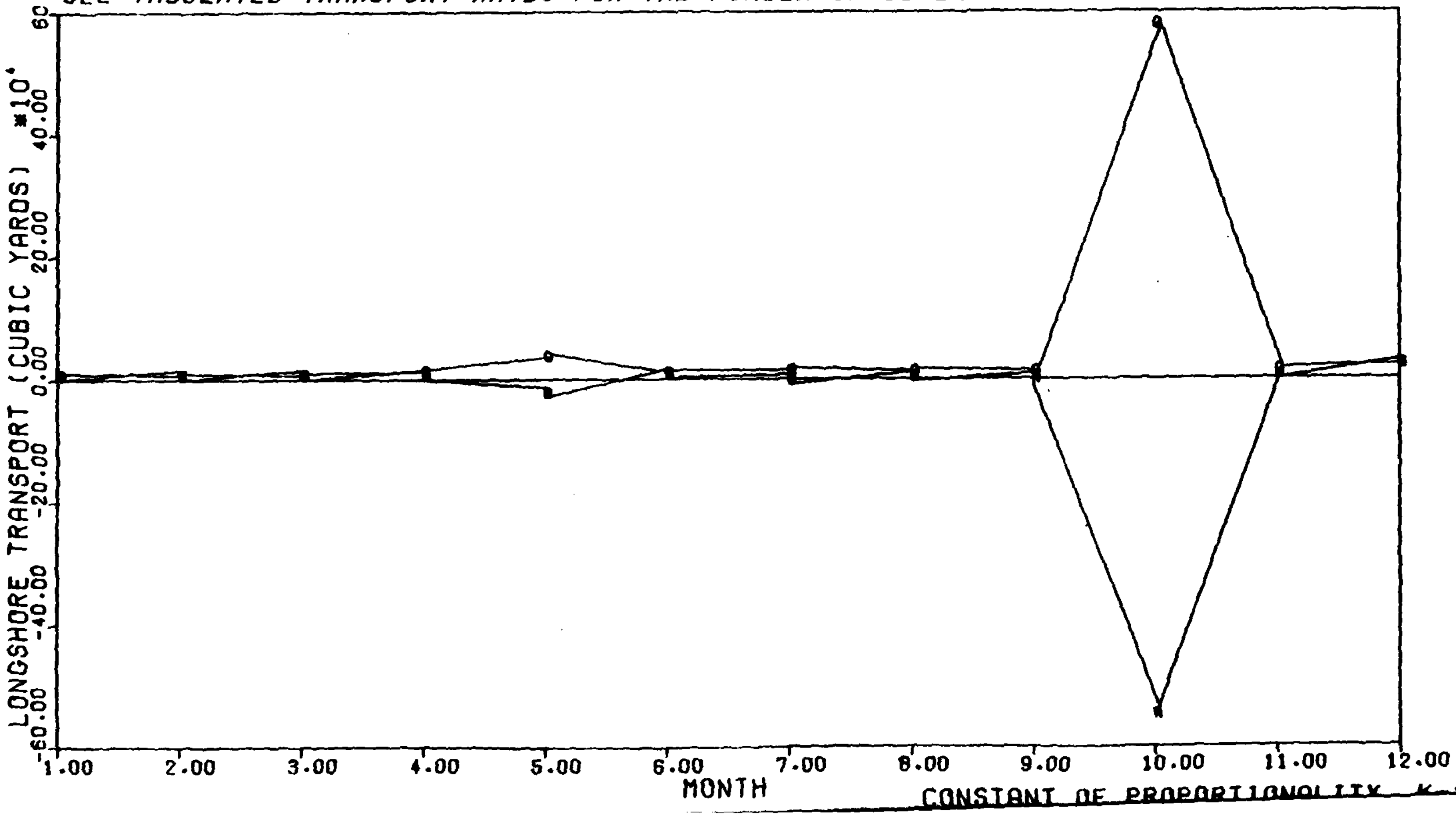
KEY

N- NET LONGSHORE TRANSPORT

G- GROSS LONGSHORE TRANSPORT

ZERO GROSS LONGSHORE TRANSPORT IMPLIES LACK OF DATA

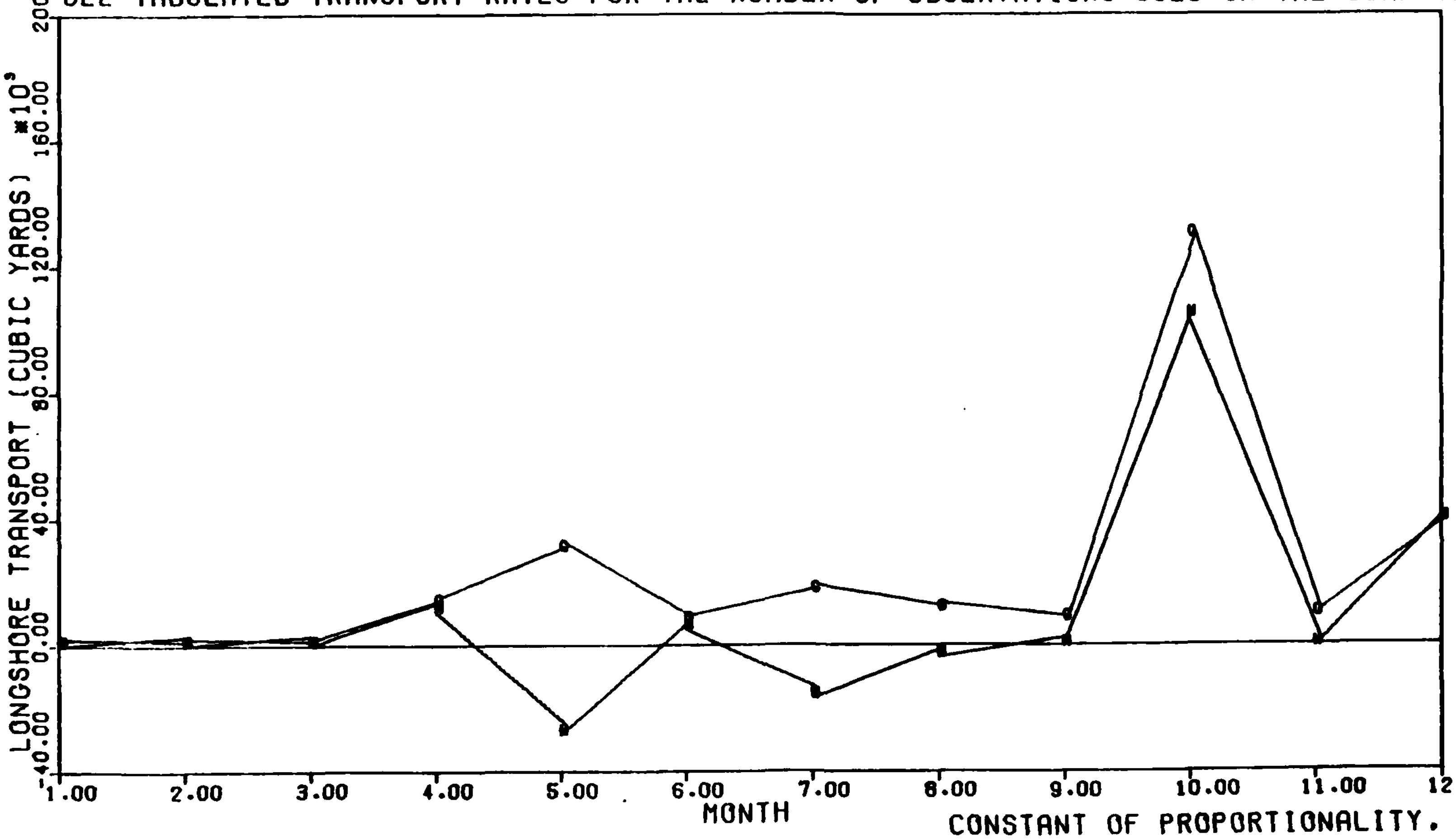
SEE TABULATED TRANSPORT RATES FOR THE NUMBER OF OBSERVATIONS USED IN THE COMPUTATIONS



CONSTANT OF PROPORTIONALITY

SITE 41012
POTENTIAL LONGSHORE TRANSPORT VERSUS TIME- 1981

KEY
N- NET LONGSHORE TRANSPORT
G- GROSS LONGSHORE TRANSPORT
ZERO GROSS LONGSHORE TRANSPORT IMPLIES LACK OF DATA
SEE TABULATED TRANSPORT RATES FOR THE NUMBER OF OBSERVATIONS USED IN THE COMPUTATIONS



CONSTANT OF PROPORTIONALITY, K=1.00

DATA FROM 41011 MAUMEE STATE PARK
OBSERVATION PERIOD 4/ 9/81 TO 12/16/81

MONTHS	1	2	3	4	5	6	7	8	9	10	11	12
MEAN NET ENERGY (FT-LBS/FT)	0.	0.	0.	-0.	-18.	2.	-5.	-2.	-4.	-344.	-0.	10.
MEAN GROSS ENERGY (FT-LBS/FT)	0.	0.	0.	4.	19.	2.	5.	4.	4.	355.	4.	10.
IMMERSED WEIGHT NET(LBS)X10000	0.	0.	0.	-63.	-4692.	499.	-1296.	-451.	-935.	-90468.	-117.	2607.
IMMERSED WEIGHT GROSS X10000	0.	0.	0.	959.	4993.	638.	1296.	928.	1034.	93484.	982.	2607.
BULK VOLUME TO LEFT (CU YDS)	0.	0.	0.	3134.	29687.	425.	7944.	4228.	6037.	563849.	3370.	0.
BULK VOLUME TO RIGHT (CU YDS)	0.	0.	0.	2745.	920.	3484.	0.	1461.	304.	9246.	2651.	15979.
BULK VOLUME NET (CU YDS)	0.	0.	0.	-388.	-28766.	3059.	-7944.	-2766.	-5733.	-554603.	-719.	15979.
BULK VOLUME GROSS (CU YDS)	0.	0.	0.	5879.	30607.	3908.	7944.	5689.	6341.	573095.	6021.	15979.
NUMBER OF OBSERVATIONS	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.

TOTAL TRANSPORT (SUM OF MONTHLY)

IMMERSED WEIGHT NET(LBS)X10000	-94917.
IMMERSED WEIGHT GROSS X10000	106920.
BULK VOLUME TO LEFT (CU YDS)	618673.
BULK VOLUME TO RIGHT (CU YDS)	36790.
BULK VOLUME NET (CU YDS)	-581883.
BULK VOLUME GROSS (CU YDS)	655463.

NB-PROPORTIONALITY CONSTANT OF 1.00 USED IN COMPUTATIONS.
ACCEPTED VALUES ARE 0.25(INMAN AND FRAUTSCHY), 0.35(DAS), 0.77(KOMAR)

DATA FROM 41012 NILES BEACH
OBSERVATION PERIOD 4/ 9/81 TO 12/16/81

MONTHS	1	2	3	4	5	6	7	8	9	10	11	12
MEAN NET ENERGY (FT-LBS/FT)	0.	0.	0.	7.	-17.	3.	-10.	-2.	-0.	64.	-0.	24.
MEAN GROSS ENERGY (FT-LBS/FT)	0.	0.	0.	8.	19.	5.	10.	7.	5.	80.	6.	24.
IMMERSED WEIGHT NET(LBS)X10000	0.	0.	0.	1771.	-4599.	801.	-2749.	-616.	-80.	16917.	-129.	6335.
IMMERSED WEIGHT GROSS X10000	0.	0.	0.	2155.	4912.	1200.	2749.	1797.	1256.	21086.	1468.	6335.
BULK VOLUME TO LEFT (CU YDS)	0.	0.	0.	1179.	29154.	1224.	16855.	7399.	4096.	12780.	4894.	0.
BULK VOLUME TO RIGHT (CU YDS)	0.	0.	0.	12033.	961.	6135.	0.	3620.	3604.	116488.	4105.	38835.
BULK VOLUME NET (CU YDS)	0.	0.	0.	10854.	-28192.	4911.	-16855.	-3779.	-492.	103708.	-789.	38835.
BULK VOLUME GROSS (CU YDS)	0.	0.	0.	13213.	30115.	7358.	16855.	11019.	7701.	129268.	8999.	38835.
NUMBER OF OBSERVATIONS	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.

TOTAL TRANSPORT (SUM OF MONTHLY)

IMMERSED WEIGHT NET(LBS)X10000	17650.
IMMERSED WEIGHT GROSS X10000	42960.
BULK VOLUME TO LEFT (CU YDS)	77581.
BULK VOLUME TO RIGHT (CU YDS)	185782.
BULK VOLUME NET (CU YDS)	108201.
BULK VOLUME GROSS (CU YDS)	263363.

NB-PROPORTIONALITY CONSTANT OF 1.00 USED IN COMPUTATIONS.
ACCEPTED VALUES ARE 0.25(INMAN AND FRAUTSCHY), 0.35(DAS), 0.77(KUMAR)

41011 MAUMEE STATE PARK   OHIO   SUMMARY FOR PERIOD STARTING 4- 9-81 AND ENDING 12-16-81.

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ALL OBS.
SURF OBS.													
HEIGHT (FT)													
MEAN	0.00	0.00	0.00	.49	.68	.21	.81	.46	.60	1.41	.57	.60	.65
STD DEV	0.00	0.00	0.00	.31	.86	.38	.78	.60	.82	2.75	.45	.68	1.14
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.	126.
PERIOD (SEC)													
MEAN	0.00	0.00	0.00	2.74	2.82	2.67	2.69	2.62	3.22	2.79	2.69	2.40	2.74
STD DEV	0.00	0.00	0.00	.42	.34	.21	.22	.19	.64	.48	.52	.27	.41
NO. OBS.	0.	0.	0.	11.	11.	6.	10.	6.	5.	10.	9.	4.	72.
DIRECTION													
PROTRACTOR METHOD													
% OCC > 90	0.00	0.00	0.00	54.55	90.00	16.67	60.00	57.14	40.00	50.00	44.44	0.00	51.39
% OCC = 90	0.00	0.00	0.00	0.00	0.00	0.00	40.00	0.00	40.00	10.00	11.11	25.00	12.50
% OCC < 90	0.00	0.00	0.00	45.45	10.00	83.33	0.00	42.86	20.00	40.00	44.44	75.00	36.11
MEAN	0.00	0.00	0.00	85.91	97.50	71.67	93.50	81.43	86.40	86.80	86.11	75.00	86.53
STD DEV	0.00	0.00	0.00	17.86	12.75	13.66	3.37	17.01	15.08	13.21	19.49	12.25	15.53
NO. OBS.	0.	0.	0.	11.	10.	6.	10.	7.	5.	10.	9.	4.	72.
BREAKER TYPE													
%OCC SPILL	0.00	0.00	0.00	60.00	50.00	11.76	53.33	28.57	33.33	53.33	50.00	50.00	42.86
SP/PL	0.00	0.00	0.00	0.00	11.11	0.00	0.00	0.00	0.00	6.67	0.00	0.00	2.38
PLUNGE	0.00	0.00	0.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.79
SURGE	0.00	0.00	0.00	13.33	0.00	23.53	13.33	21.43	16.67	6.67	25.00	0.00	13.49
CALM	0.00	0.00	0.00	20.00	38.89	64.71	33.33	50.00	50.00	33.33	25.00	50.00	40.48
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.	126.
CURRENT OBS.													
(FT/SEC)													
NET MEAN	0.00	0.00	0.00	-.01	-.18	.17	-.14	-.03	.05	.20	.14	.26	.04
GROSS MEAN	0.00	0.00	0.00	.35	.24	.27	.21	.16	.11	.32	.23	.33	.25
STD DEV	0.00	0.00	0.00	.24	.25	.27	.19	.17	.16	.29	.28	.32	.21
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.	126.
FORESHORE SLOPE													
MEAN (DEG)	0.00	0.00	0.00	5.53	6.33	6.53	6.07	5.57	6.00	4.93	5.67	5.13	5.81
STD DEV	0.00	0.00	0.00	2.33	1.68	3.52	1.75	1.79	2.30	2.31	1.72	2.10	2.25
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.	126.
RIPS % OCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN SPAC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	11.	0.	117.
CUSPS % OCC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN SPAC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	11.	0.	117.

41012 NILES BEACH OHIO SUMMARY FOR PERIOD STARTING 4- 9-81 AND ENDING 12-16-81.

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ALL OBS.
SURF OBS.													
HEIGHT (FT)													
MEAN	0.00	0.00	0.00	.54	.67	.25	.79	.52	.51	1.23	.65	.83	.65
STD DEV	0.00	0.00	0.00	.44	.86	.42	.79	.55	.69	1.09	.57	.96	.76
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.	126.
PERIOD (SEC)													
MEAN	0.00	0.00	0.00	3.00	2.86	2.54	2.70	2.62	2.82	2.65	2.63	2.48	2.72
STD DEV	0.00	0.00	0.00	.81	.32	.31	.22	.35	.57	.33	.48	.25	.46
NO. OBS.	0.	0.	0.	11.	11.	7.	10.	9.	5.	11.	9.	4.	77.
DIRECTION													
PROTRACTOR METHOD													
% OCC > 90	0.00	0.00	0.00	36.36	63.64	14.29	90.00	66.67	40.00	45.45	44.44	0.00	49.35
% OCC = 90	0.00	0.00	0.00	9.09	18.18	0.00	10.00	0.00	20.00	9.09	11.11	25.00	10.39
% OCC < 90	0.00	0.00	0.00	54.55	18.18	85.71	0.00	33.33	40.00	45.45	44.44	75.00	40.26
MEAN	0.00	0.00	0.00	83.18	96.82	69.71	98.50	87.78	91.40	79.18	84.44	77.50	86.25
STD DEV	0.00	0.00	0.00	23.16	15.85	17.90	5.30	22.65	23.39	21.89	23.51	9.57	20.40
NO. OBS.	0.	0.	0.	11.	11.	7.	10.	9.	5.	11.	9.	4.	77.
BREAKER TYPE													
%OCC SPILL	0.00	0.00	0.00	53.33	50.00	11.76	46.67	28.57	25.00	40.00	25.00	50.00	36.51
SP/PL	0.00	0.00	0.00	0.00	11.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.59
PLUNGE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SURGE	0.00	0.00	0.00	26.67	0.00	29.41	20.00	35.71	16.67	33.33	50.00	0.00	23.81
CALM	0.00	0.00	0.00	20.00	38.89	58.82	33.33	35.71	58.33	26.67	25.00	50.00	38.10
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.	126.
CURRENT OBS.													
(FT/SEC)													
NET MEAN	0.00	0.00	0.00	.04	-.15	.07	-.12	-.12	-.05	.34	.07	.34	.03
GROSS MEAN	0.00	0.00	0.00	.24	.21	.14	.18	.15	.13	.47	.23	.38	.23
STD DEV	0.00	0.00	0.00	.28	.26	.18	.22	.20	.23	.53	.26	.43	.28
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	12.	8.	126.
FORESHORE SLOPE													
MEAN (DEG)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.43	0.00	0.00	0.00	0.00	.05
STD DEV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.00	.55
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	14.	12.	15.	11.	0.	117.
RIPS % OCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN SPAC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	13.	12.	15.	11.	0.	116.
CUSPS % OCC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN SPAC.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. OBS.	0.	0.	0.	15.	18.	17.	15.	13.	12.	15.	11.	0.	116.

SUPPLEMENT 2

OHIO DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL SURVEY

OPEN FILE REPORT 82-1

A TRACER-SAND STUDY OF LITTORAL TRANSPORT, MAUMEE BAY STATE PARK, LUCAS COUNTY, OHIO

by

Jonathan A. Fuller

1982

A TRACER-SAND STUDY OF LITTORAL TRANSPORT, MAUMEE BAY STATE PARK, LUCAS COUNTY, OHIO

Jonathan A. Fuller
ODNR, Division of Geological Survey

ABSTRACT

In October 1981, 50 cubic yards of a tracer sand was placed in the nearshore environment of Lake Erie at Maumee Bay State Park. The movements of the sand were monitored over a 7-month period and first showed a rapid redistribution of the sand, with movement onshore and primarily westward along the beach face. Continued longshore movement of the sand was observed throughout the ice-free period until waves on a raised water level, caused by a strong storm from the northeast, pushed the sand behind the beach, effectively removing it from the beach-nearshore system and the study area.

INTRODUCTION

On October 20, 1981, the U.S. Army, Corps of Engineers, in cooperation with the Ohio Department of Natural Resources Division of Parks, Office of the Chief Engineer, and Division of Geological Survey,[1] had 50 cubic yards of sand placed in the nearshore environment along the shoreline of Maumee Bay State Park, Lucas County, Ohio. The primary purpose of this project was to monitor, for a 7-month period, the movement of the placed sand within the nearshore environment. An extension of this study which will continue data collection for a year-long period is in progress. The report on the extended study will present the additional time-sequence data as well as beach data which were not compiled for this open-file report.

The study area is located on the Lake Erie shore about ¼ mile east of Norden Road (fig. 1). A baseline 1,000 feet long running approximately parallel to and 30 feet landward of the shoreline was surveyed in from a Corps of Engineers benchmark. Survey lines, perpendicular to the baseline, were run 400 feet into the lake at a spacing of 100 feet along the baseline. Two additional survey lines were run 200 feet into the lake from the baseline at locations 50 feet from either side of the central survey line (fig. 2). Prior to sand placement, elevations were recorded every 20 feet lakeward from the baseline on all survey lines. Additional elevations were taken on a 10-foot grid within the area enclosed by the two 200-foot survey lines.

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[1]U.S. Army, Corps of Engineers, 1981, Scope of work for Maumee Bay State Park, Ohio, Littoral transport test: Memo of understanding enclosed with letter from U.S. Army, Corps of Engineers Colonel G. P. Johnson to Ohio Department of Natural Resources Director R. W. Teater, Sept. 8, 1981.

Sand from the Sidley Sand and Gravel Quarry at Thompson, Ohio, was used because it contrasted with the native beach sand in color, composition, roundness, and size distribution. It was felt that the movement of this contrasting sand could easily be traced within the nearshore environment.

Most of the 50 cubic yards of tracer sand was emplaced by a tracked front-end loader along the central survey line. Following placement, elevations were again measured on the 10-foot grid in the area of sand placement. The resulting placed sand pile was about 110 feet long, 12 feet wide at the base, and a maximum of 1.5 feet thick. The shore end of the pile was at the average waterline for October (about 30 feet lakeward of the baseline) as defined by the mean lake level at the Toledo gauge. The sand was placed during a west wind, which had lowered the water level; this greatly simplified the placement operation.

REPETITIVE SURVEYS

Repetitive surveys were made along at least the center survey line (where the sand was placed) and the survey lines on either side of the center line at 50 and 100 feet. Elevations were recorded at 10-foot intervals from the baseline to 200 feet and at 20-foot intervals farther out to at least 300 feet (weather and water levels permitting). Repetitive surveys were made on October 23, November 17 and 25, December 15, 1981, and March 29, April 12, May 4, and June 7, 1982. Nonsurvey site visits were also made on November 20, 1981, and March 8, 1982. Core samples were obtained at predetermined points along the survey lines during the repetitive surveys. These cores were taken through any surface sand present and into the clay below. Field descriptions of the core samples and of the beach face support the findings described below, showing that the movement of the placed sand was onshore and primarily to the west. Laboratory analyses of the samples may allow identification of trace occurrences of placed sand in more cores, which in turn could give a broader view of the sand movement within the area.

Repetitive surveys were made with tagline and transit. Elevations were recorded to the nearest tenth of a foot. Differences between surveys were calculated and contoured on a 0.3-foot interval after an initial 0.3-foot departure from a no-change situation. Calculations of volume of erosion or deposition were made by planimetering the areas of the closed contours on the change-of-elevation contour maps and multiplying the areas by the 0.3-foot contour interval.

Elevation changes associated with the placed sand occurred totally within 200 feet of the baseline and could not be measured beyond 100 feet on either side of the central survey line, therefore the following discussion will be limited primarily to this area (200 feet by 200 feet, fig. 2).

Figure 3 shows the placed sand as deposited (by front-end loader) on the existing surface; the volume of sand accounted for in this map is 45 cubic yards. The first repetitive survey was done, following a small storm, 3 days after sand placement. The storm from the north raised the water level to 572.89 feet above sea level (reference IGLD), which was 1.27 feet above the mean level for October as recorded by the NOAA/NOS Toledo water-level gauge. Winds averaged 11.4 knots from the ENE for 15 hours before moving around to the NNE with an average speed of 6.2 knots for 21 hours as recorded

by NOAA at the Toledo Express Airport. Initial movement of the placed sand was rapid, with movement being toward the shore and to both the east and west along the beach. Volume estimates from the change-of-elevation contours (fig. 4) show a minimum of 40 cubic yards of material eroded from the placed-sand area. Deposition of 23 cubic yards of material can be seen to the west and onshore, and deposition of 9 cubic yards to the east also can be documented.

The repetitive survey on November 17, 1981, showed that the placed sand had been effectively removed from the nearshore area. Movement was again onshore but longshore movement was dominantly westward. Some backshore dune development included placed sand, and small washover fans extended back to near the baseline. A trace of sand, with macroscopic characteristics of the placed sand, was found on the active beach face 500 feet west of where the sand was placed (at the western end of the full study area). Volume estimates from the change-of-elevation contours for the time between October 23 and November 17 (fig. 5) show that at least 11 of the 23 cubic yards of sand which had moved onshore and to the west at the time of the previous survey had been eroded by this visit. The same trend was true east of the center line, where at least 5 cubic yards of sand were removed from the area which had previously had 8 cubic yards of deposition.

Areas of deposition between October 23 and November 17 were limited to the immediate beach area, where placed sand was found annealed to the beach. The volume of sand which could be documented as being added to the beach was only about 6 cubic yards.

A nonsurvey site visit was made on November 20 to take advantage of the fact that a strong southwest wind had effectively drained the whole study area. This visit confirmed what previous samples had implied; that there had been no detectable movement of placed sand in the offshore direction.

The November 25 survey visit showed few changes which could be detected visually, and measurements showed that the material which had previously been annealed to the beach face had been removed (fig. 6). There was some washover-fan development on the back beach which removed some of the placed sand from the normal nearshore processes. Minor movement of the tracer sand to the west was again noted, although visual identification of the sand was getting progressively more difficult. Subsequent surveys didn't show significant measurable deposition which could be attributed to the placed sand anywhere within the repetitive survey area.

Generally speaking, minor net erosion occurred at the shoreline between November 25 and December 15 and again between December 15 and March 29, although through most of this latter period the lake was frozen.

On April 5 and 6, 1982, a storm from the northeast allowed waves on a raised water surface (at least 3.5 feet above the monthly average) to significantly alter the area. The clay notch at the shoreline was cut shoreward and the whole clay shelf was reduced in elevation. Nearly all the sand which had accumulated at the shoreline (including the placed sand) was picked up and driven behind the baseline into the marsh in the form of a 1.5-foot-thick washover fan.

The next survey (May 5, 1982) showed erosion along the area of the

now-submerged baseline + 30 feet with accretion at the shoreface, which was at baseline + 20 feet. This balance was probably in response to reestablishment of shoreform equilibrium after the storm of April 5. The last survey done for this report (June 7, 1982) showed continued shore erosion pushing the shoreline and clay notch landward. This survey also showed significant removal of bottom material from the offshore portion of the area of concentration within the study area (between 160 feet and 200 feet offshore).

SUMMARY AND CONCLUSIONS

Approximately 50 cubic yards of a tracer sand was placed in the nearshore environment at Maumee Bay State Park. The original sand placement extended 110 feet from shore to baseline + 140 feet. Throughout the 7-month study no offshore movement of the sand was detected, even during a low-water visit on November 20 which allowed a visual search of the offshore bottom area for traces of the placed sand. The response of the sand to the natural processes of the area was to move onshore, becoming annealed to the beach, and alongshore, primarily in a westward direction. All of the exposed placed sand had been removed to the beach within one month of placement, and a minor amount of sand was detected at least 500 feet west of the placement site. The net bottom elevations remained reasonably stable between November 17, 1981, and April 5, 1982, with some continued longshore movement of the placed sand to the west. A storm on the night of April 5 effectively pushed all the shoreface sand onshore, removing it from the survey area.

A cumulative erosion map of the 200-by-200-foot area of concentrated study (fig. 2 and fig. 7) shows an overall removal of material from the area with reductions in elevation of as much as 1.6 feet at the shoreline. A minimal amount of material was removed from the area between baseline + 40 feet and baseline + 150 feet. Lakeward of baseline + 150 feet the amount of material removed increases.

Results of monitoring the movement of the placed sand suggest reasonably rapid movement to the west, which would fill any retaining structure placed at the west end of the beach. The other change noted during this study was due to an extreme weather event, which moved sand from the shoreline, across the clay shelf, and into the marsh. This event demonstrated the vulnerability of this shoreline to both changes of lake level as well as wave attack and the potential for removal of beach material due to wholesale landward movement.

Lakeward movement of the placed sand was not observed in this study, but cumulative erosion, through the study period, of the bottom at baseline + 200 feet documents that had sand been placed at that position, it would not have been in a stable environment.

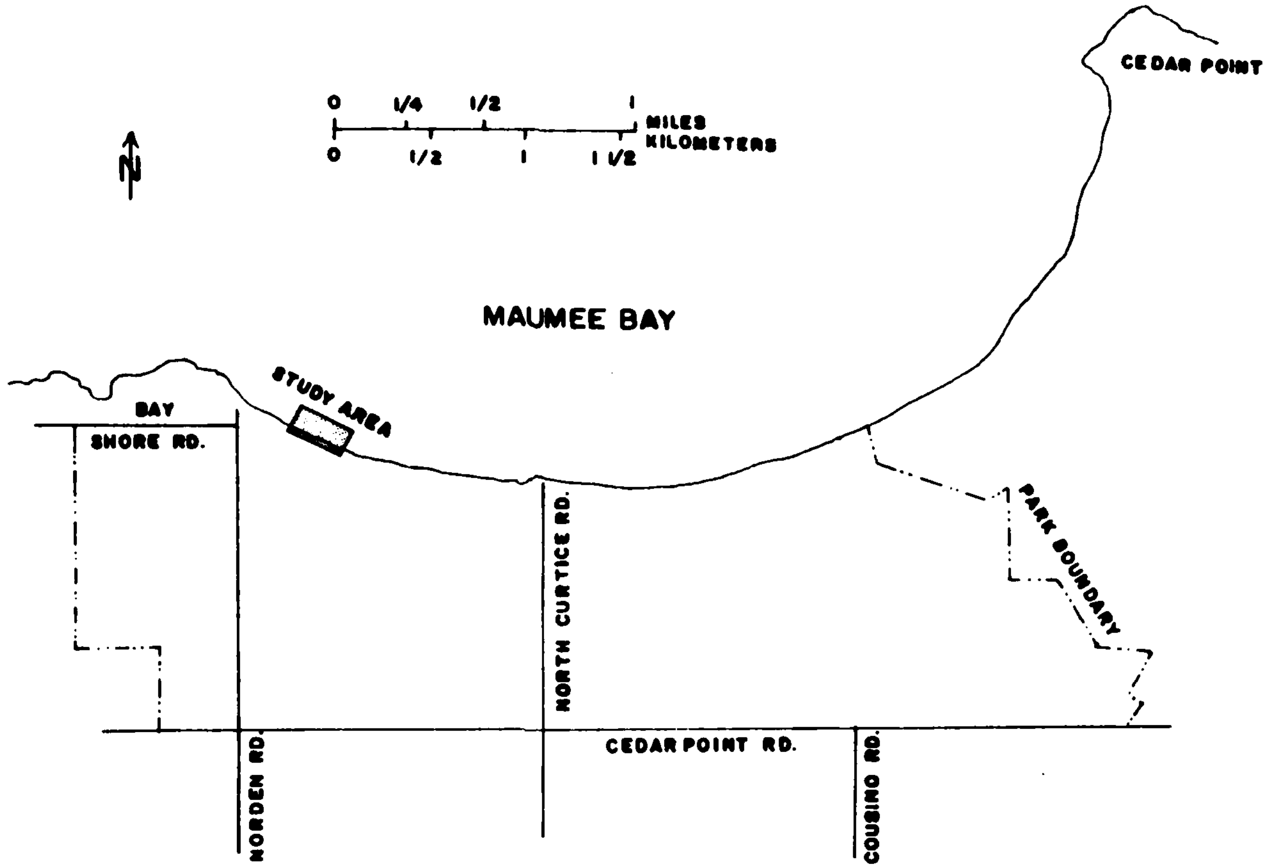


FIGURE 1.—Location of study area.

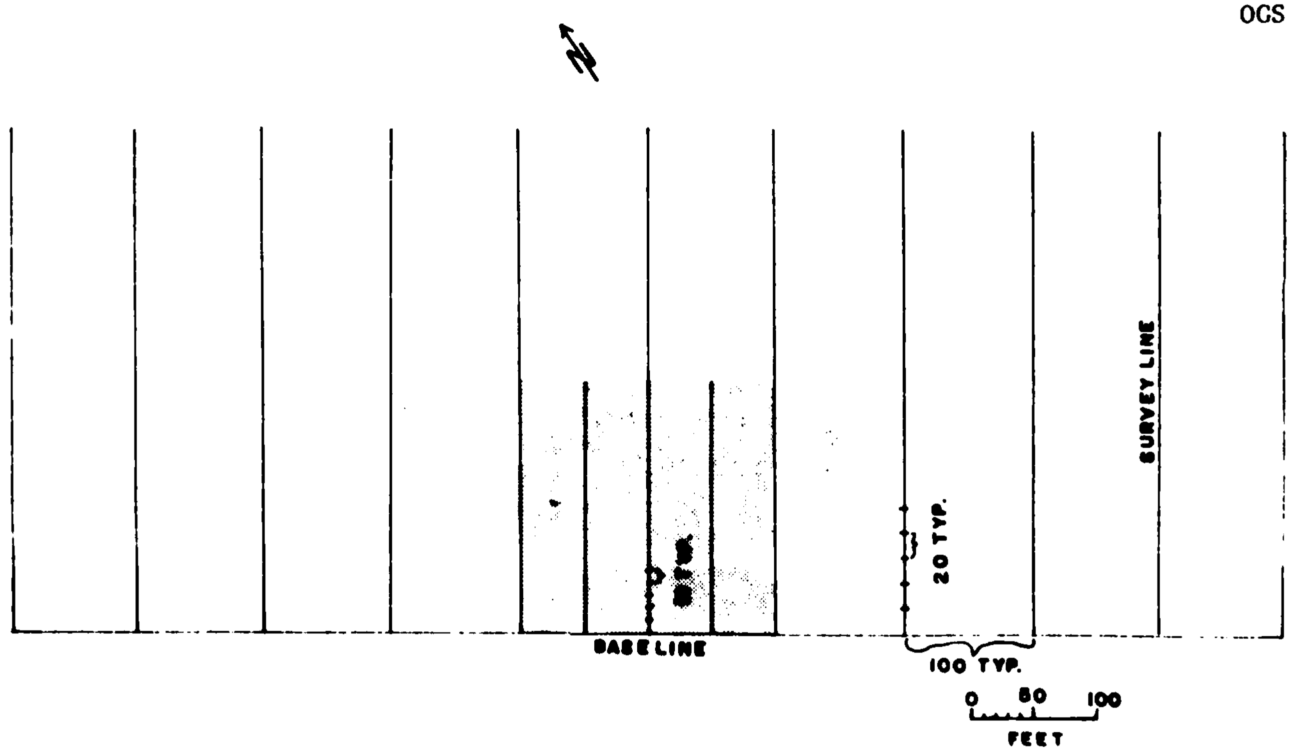


FIGURE 2.—Study area with full baseline. Shaded area is area covered by additional figures.

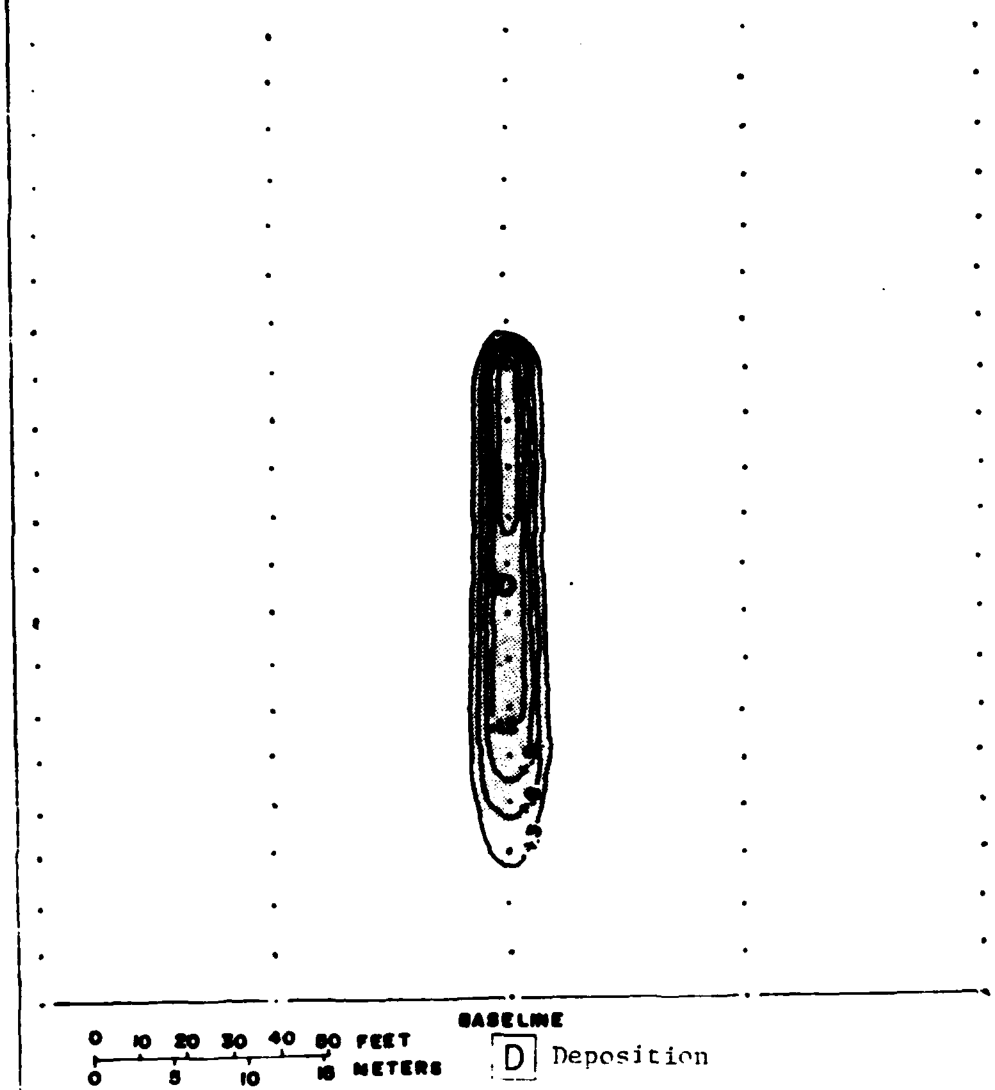


FIGURE 3.—October 20 change-of-elevation map showing deposition of sand during placement: contour interval 0.3 foot.

OGS OF 82-1

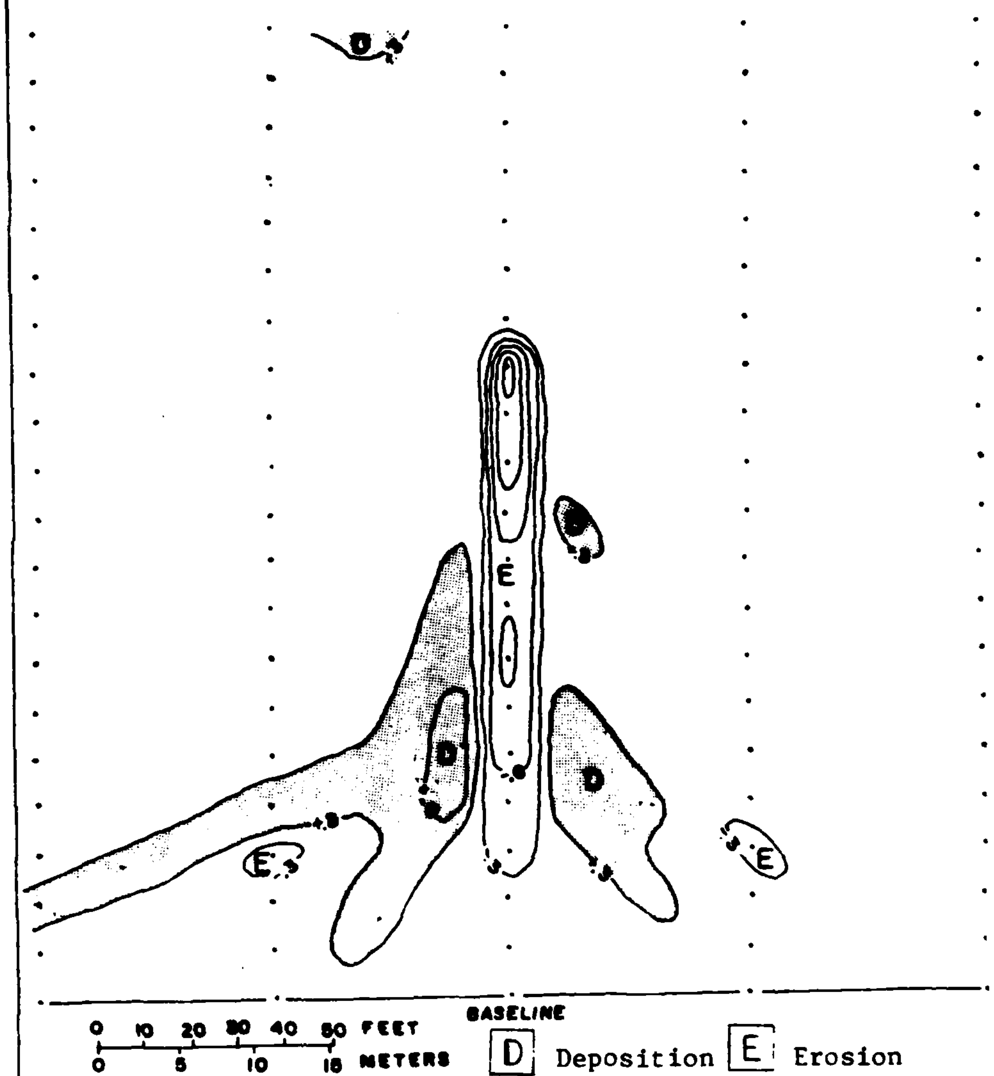


FIGURE 4.—October 20-October 23 change-of-elevation map; contour interval 0.3 foot.

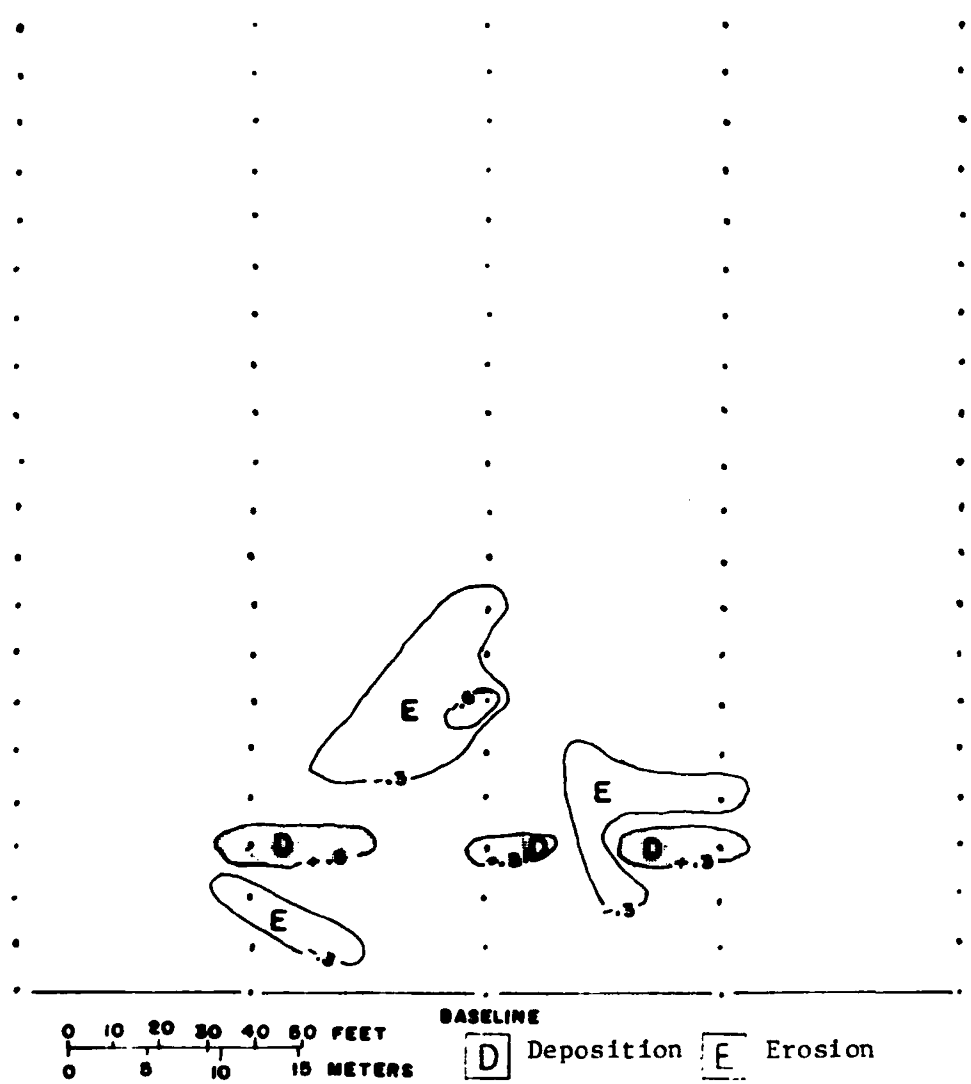


FIGURE 5.—October 23-November 17 change-of-elevation map: contour interval 0.3 foot.

OGS OF 82-1

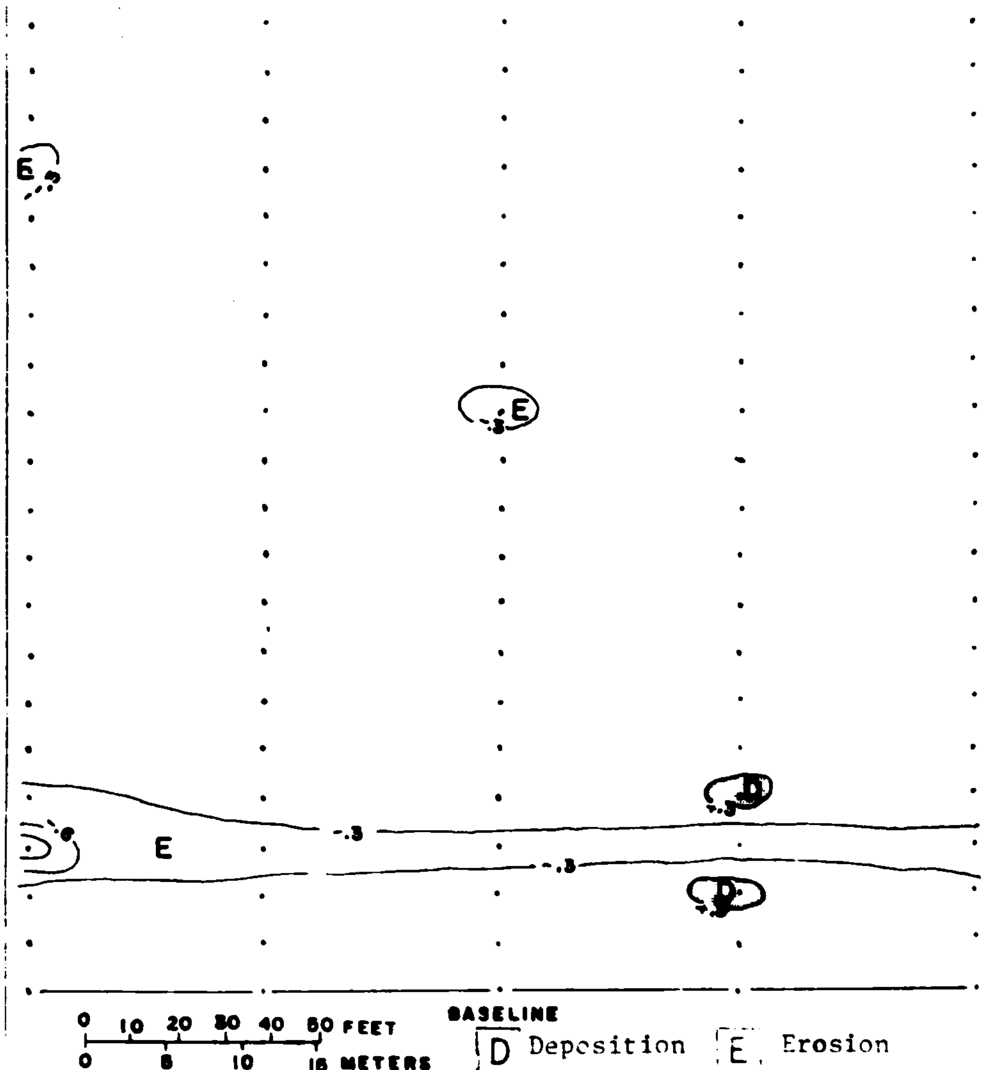


FIGURE 6.—November 17-November 25 change-of-elevation map; contour interval 0.3 foot.

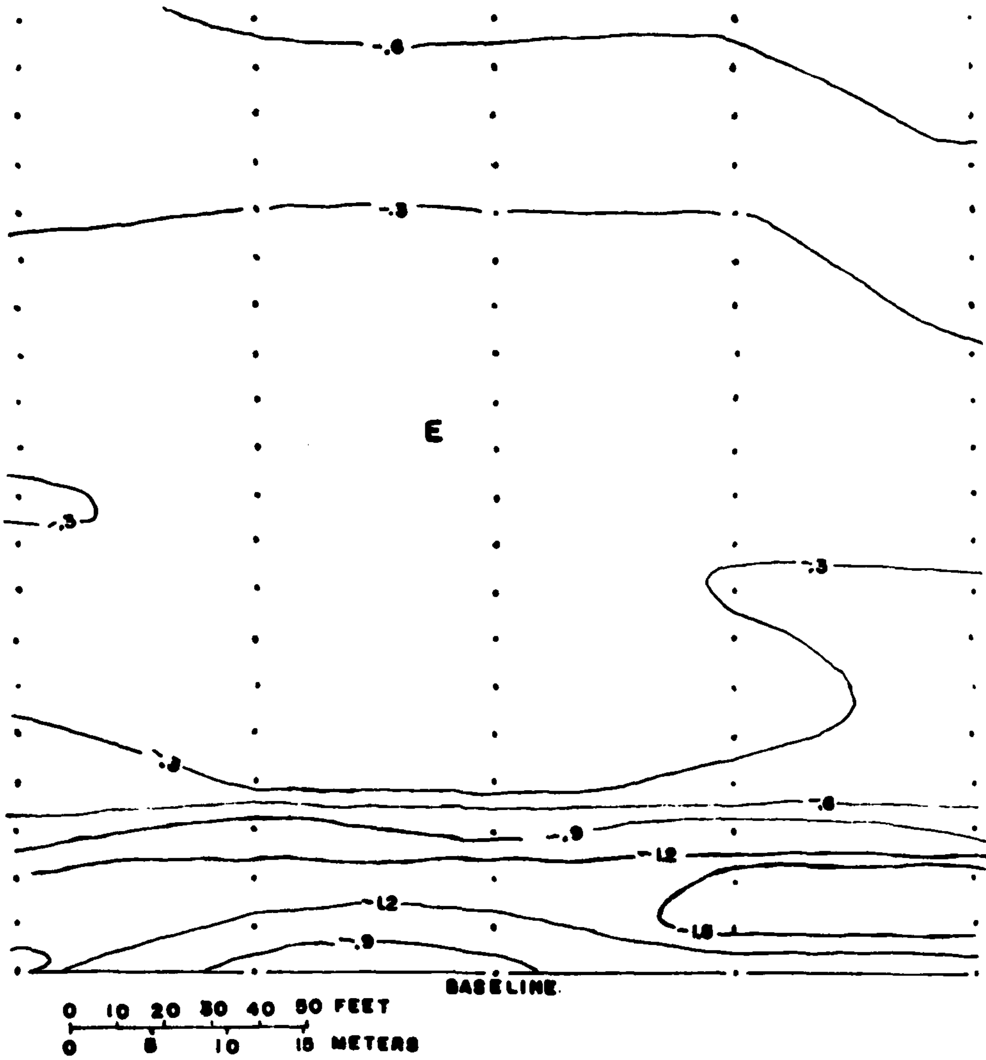


FIGURE 7.—Cumulative erosion, October 20, 1981-June 7, 1982, change-of-elevation map; contour interval 0.3 foot. All points showed erosion.

APPENDIX E
CORRESPONDENCE

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

MAUMEE BAY STATE PARK

FINAL FEASIBILITY REPORT (STAGE 3)

PERTINENT CORRESPONDENCE

APPENDIX E

TABLE OF CONTENTS

EXHIBITS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

OHIO DEPARTMENT OF NATURAL RESOURCES

Director's Office
FOUNTAIN SQUARE · COLUMBUS, OHIO 43224 · (614) 466-377(

James A. Rhodes
Governor

Robert W. Teater
Director

March 21, 1975

Colonel James E. Hays
District Engineer- Detroit
U.S. Army Corps of Engineers
150 Michigan Avenue
Detroit, Michigan 48221

Dear Colonel Hays:

The Department of Natural Resources requests the Corps to initiate a reconnaissance study under the cooperative shore protection program for Maumee Bay State Park. A map of the area with property lines indicating limits of state ownershi is attached.

This area is a recent acquisition by the department and development is in the planning stages. The shoreline is presently in state ownership. In order for development to be feasible, shore protection for beach stabilization and flood protection must be installed. We desire to pursue a federal project or projects to effectively provide a lake-shore recreation area in northwestern Ohio. A preliminary development plan is enclosed. This plan has not been approved as our final development plan and presently is only a proposal.

Your consideration of this request would be greatly appreciated.

Sincerely,

Robert W. Teater

ROBERT W. TEATER
Director

RWT:bm
Attach.

cc: R. L. Lucas

Exhibit 1

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

NCBED-PW 31 October 1978

SUBJECT: Proposed Schedule of FY 79 Study Activities for Western Lake Erie Shore, OH, Feasibility Study

Division Engineer, North Central
ATTN: NCDPD-PF

1. The purpose of this correspondence is to obtain your views and comments on Buffalo District's proposed course of action for the FY 79 efforts on the subject feasibility study.

2. By resolution dated 11 April 1974, the House Public Works Committee authorized the subject study to determine the advisability of providing beach erosion control, flood protection and related purposes along a 53-mile reach of Lake Erie shoreline between the Michigan/Ohio State Line and Marblehead, OH.

3. On 5 April 1978, Dr. Robert W. Teater, Director of Ohio Department of Natural Resources (ODNR) testified before the Senate and House Subcommittees on Public Works and requested that $200,000 be added to the Corps' FY 79 budget so that this study could be initiated and that erosion problems along the shoreline of Maumee Bay State Park be given top priority. A copy of Dr. Teater's testimony, along with other correspondence on the Maumee Bay Beach Erosion Project, is enclosed.

4. For this new start, we estimate that about $100,000 to $130,000 of the $200,000 in the FY 79 budget will be required to prepare the Reconnaissance Report. Because it is a new area recently transferred from Detroit District to Buffalo, and because preliminary design of alternatives and economic analysis apparently are required in a Reconnaissance Report to show justification for going into Stage 2, I estimate that the draft Reconnaissance Report will not be completed until the 4th quarter of FY 79. For these reasons, and because ODNR has stated that the top priority problem under this study authorization is erosion at Maumee Bay State Park (reference ODNR's Congressional testimony), I would prefer to initiate the PFR (Stage

Exhibit 2

NCBED-PW
SUBJECT: Proposed Schedule of FY 79 Study Activities for Western Lake Erie Shore, OH, Feasibility Study

2) for Maumee Bay State Park prior to completion of the recon to effectively expend the remaining $70,000 to $100,000 in FY 79 and at the same time be responsive to the customer's desire. The justification for going into Stage 2 on Maumee Bay State Park as a 1st Interim Report is the favorable Section 103 Letter Report by Detroit District dated 14 November 1976. During a meeting with ODNR on 8 March 1978, it was determined that the size of project desired by State of Ohio was greater than could be developed under Section 103 authority. They agreed to have the study performed under the Western Lake Erie Shore authorization. To minimize the possibility that there are other problem areas in the study area to which ODNR might assign a higher priority than Maumee, we plan to conduct two (2) or three (3) agency workshops and at least one (1) orientation public meeting in the area before initiating work on the Maumee Interim Report. If a higher priority location does surface, I would propose an alternate course of action at that time.

5. Therefore, I recommend initiation of the PFR for the 1st Interim Report on beach erosion at Maumee Bay State Park concurrently with the overall Reconnaissance Report, contingent upon the conditions identified above.

6. Your comments on and approval of this recommendation are requested.

1 Incl
as

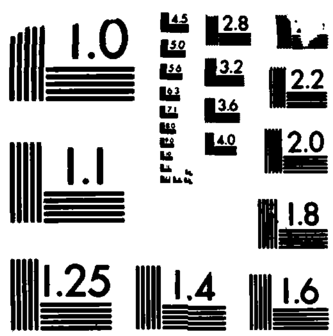
Daniel D. Ludwig
DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

CF:
NCBED-PW
NCBRO

DELAPLANTE
ZORICH
GILBERT
HALLOCK
LIDDELL
BRAUN

AD-A138 420 MAUMEE BAY STATE PARK OHIO SHORELINE EROSION BEACH RESTORATION STUDY FINA..(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT DEC 83 3/6

UNCLASSIFIED F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Rec'd 11 Nov

8 NOV 1978

NCDPD-PF (31 Oct 78) 1st Ind
SUBJECT: Proposed Schedule of FY 79 Study Activities for Western Lake Erie Shore, OH, Feasibility Study

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605

TO: HQDA (DAEN-CWP-C), WASH DC 20314

1. Forwarded, recommending approval contingent on the District complying with applicable comments (Incl 2 and 3) previously provided on the Section 103 Reconnaissance Report.

Richard L. Harris
RICHARD L. HARRIS
Major General, USA
Division Engineer

3 Incl
Incl 2 & 3 Added
2. Indorsements to Section 103 Recon Rpt.
3. NCDPD-PF ltr 15 Dec 76 w/comments

DAEN-CWP-C(NCBED-PW, 31 Oct 78) 2d Ind
SUBJECT: Proposed Schedule of FY 79 Study Activities for Western Lake Erie Shore, OH, Feasibility Study

DA, Office of the Chief of Engineers, Washington, D. C. 20314 16 Nov 78

TO: Division Engineer, North Central, ATTN: NCDPD-PF

1. I approve the Buffalo District suggested proposal on how they plan to proceed on the authorized study in FY 1979. Study of the total reach would be initiated including initiation of an interim report. The interim report would start in Stage 2 (Checkpoint 3) on a reach of shoreline in a ne state park - Maumee Bay State Park. This reach was earlier investigated by Detroit District and a Section 103 reconnaissance report was approved by your office in December 1976.

2. We will place the Section 103 study in a deferred status pending approva of Checkpoint 7 report documents for the interim report and upon receipt of your recommendation to proceed or drop the requested DPR study under the Section 103 authority.

FOR THE CHIEF OF ENGINEERS:

3 Incl
nc

ALEX SHWAIKO
Chief, Planning Division
Directorate of Civil Works

CF:
Buffalo Dist.

Exhibit 4

NCDPD-PF (NCBED-PW, 31 Oct 78) 3rd Ind 28 NOV 1978
SUBJECT: Proposed Schedule of Fy 79 Study Activities for Western Lake Erie Shore, OH, Feasibility Study

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605

TO: District Engineer, Buffalo

Forwarded for information and compliance.

FOR THE DIVISION ENGINEER:

3 Incl
nc

ALFRED P. BERM, P.E.
Chief, Planning Division

Exhibit 5

U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

RESOLUTION

Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report, Lake Erie Shore Line from the Michigan-Ohio State Line to Marblehead, Ohio, published as House Document Number 63, 87th Congress, 1st Session, and other pertinent reports, with a view to determining the advisability of providing for beach erosion control, flood protection and related purposes in the study area, with particular reference to the advisability of protection work against storm waves and wind generated high lake levels.

Adopted April 11, 1974

Attest: John A. Blatnik

John A. Blatnik, M.C.
Chairman

Requested by: Hon. Delbert L. Latta

Exhibit 6

ODNR

Ohio Department of Natural Resources

July 30, 1976

U. S. Army Corps of Engineers
Department of the Army
P. O. Box 1027
Detroit, Michigan 48231

Attention: LTC. Carl B. Sciple
Acting District Engineer

Dear Colonel Sciple:

Reference is made to your letter of July 23, 1976 regarding a possible shore protection project under the authority of Section 103 of the 1962 River and Harbor Act for Maumee Bay State Park.

As stated in our March 21, 1975 letter requesting your assistance in providing shore protection for this area, extensive development of this park is not feasible until proper protection has been provided. We believe that the authority under Section 103 is still the most expedient authority to accomplish this protection and request an early completion of the reconnaissance study.

We would welcome the opportunity to review the reconnaissance study upon its completion, but based upon the cost estimate contained in your letter, this department continues to support this project and looks forward to an early completion of design plans and construction.

Sincerely,

Robert W Teater

ROBERT W. TEATER
Director

RWT:gfs

Exhibit 7

JAMES A. RHODES Governor • ROBERT W. TEATER Director

NCBED-PW 6 April 1979

Dr. Robert W. Teater
Ohio Department of Natural Resources
Fountain Square
Columbus, OH 43224

Dear Dr. Teater:

The purposes of this letter are to request from the State of Ohio, a letter of intent that the State plans to proceed with their development of the Maumee Bay State Park area and to furnish my interpretation regarding Federal involvement in the development of a shoreline protection project at Maumee Bay State Park.

The Office of the Chief of Engineers has informed me that, prior to the Buffalo District initiating study activities at the proposed park site, the State must indicate that it has plans to accomplish park development in advance of or concurrently with any proposed Federal project to assure realization of the benefits claimed. Since I will initiate the study in the near future, I would appreciate a letter stating your intent to develop the park prior to, or concurrent with, any Federal project.

Regarding the type of shoreline development proposed, I have enclosed a copy of the tentative master plan (Inclosure 1) indicating what we think at present is the Federal involvement in the development of a shoreline protection project at Maumee Bay State Park. Our interpretation is based on discussions with the Department. Of particular importance is the portion of the shoreline proposed for a recreation beach, as the benefit category is different for the beach than it would be for the shoreline without a beach. Please let me know if our interpretation of shoreline use is correct or if there have been any modifications or deletions since our last discussions with your staff. Because I plan to begin work on the Maumee Bay State Park Study soon, your prompt response would be appreciated.

If you have any questions or clarification is required regarding this matter, do not hesitate to contact me or my project manager,

ls/2294

NCBED-PW
Dr. Robert W. Teater

Mr. James H. DeLaPlante III at (716)876-5454, extension 2294. Your continued cooperation is appreciated.

Sincerely yours,

1 Incl
as stated

DANIEL D. LUDWIG, PE
Colonel, Corps of Engineers
District Engineer

CF:
NCBED-PW

DeLaPlante_______
Zorich_______
Gilbert_______
Hallock/
Liddell_______
Braun_______
Ludwig_______

ODNR

Ohio Department of Natural Resources
Fountain Square · Columbus Ohio 43224 · (614) 466-3770

April 17, 1979

Daniel D. Ludwig, P.E.
Colonel, Corps of Engineers
District Engineer
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

We are in receipt of your letter of April 6, 1979 regarding the erosion protection study for Maumee Bay State Park.

As indicated in earlier correspondence this department is fully committed to the development of a major recreational area at Maumee Bay State Park. We are presently designing the camping area for start of construction this summer and will shortly begin design work on the lodge complex. It is our intent to complete all facilities shown on the master plan as expediently as funds for same are made available. This includes the facilities for the large beach complex as shown on the master plan.

Most of these facilities cannot be constructed until adequate erosion protection has been installed. Therefore, it is imperative that your study and plans be developed as soon as possible.

The proposed shoreline development is tentatively as shown on the master plan included with your letter. In developing your study it may be more appropriate to use the limits of the beach as the western property line and the end of North Curtice Road.

I appreciate your continued interest and cooperation in the development of this state park.

Sincerely,

Robert W. Teater

ROBERT W. TEATER
Director

RWT:bm
cc: Donald Olson
Robert Lucas
James A. Swartzmiller

Exhibit 9

SJ/2294

NCBED-PW

6 January 1981

James Swartzmiller, Chief Engineer
Ohio Department of Natural Resources
Office of Chief Engineer
Fountain Square
Columbus, OH 43224

Dear Mr. Swartzmiller:

During a recent visit to Maumee Bay State Park by members of my staff, it was noted that construction of the campgrounds was nearing completion. We understand that the buildings constructed to date have been built above the 100-year peak level of 577.3 IGLD. This is consistent with the flood potential and in keeping with the recommendations of our Shoreline Erosion and Beach Restoration Study at Maumee Bay State Park. We suggest and assume that future development will also be constructed consistent with this flood potential.

If you have any questions on this matter, please let me know.

Sincerely,

DONALD M. LIDDELL
Chief, Engineering Division

CF:
NCBED-PW

Mammoser_______
Zorich_______
Gilbert_______
Hallock_______
Liddell_______

Exhibit 10

7-d/2294

NCBPD-WB 16 December 1981

Dr. Robert W. Teater, Director
Ohio Department of Natural Resources
Fountain Square, Building B
Columbus, OH 43224

Dear Dr. Teater:

The purpose of this letter is to request a Letter of Intent to provide assurances of Local Cooperation for the proposed Corps of Engineers Shoreline Protection project at Maumee Bay State Park.

We are currently in the process of completing the Draft Final Feasibility Report, which will then be forwarded to our North Central Division office, for their comments and approval. When the report becomes final (currently scheduled for Oct 82), it will be sent to the Board of Engineers for Rivers and Harbors (BERH) for review. A signed Letter of Intent must accompany the Final Report when it is transmitted to NCD.

The Items of Local Cooperation are listed below as they appear in the Draft Report and are, therefore, subject to change. Your Letter of Intent to provide assurances of Local Cooperation is not legally binding, but substantiates your interest in the project to reviewing agencies. The indicated percentages of participation are subject to change based on the then current administration policies. Dollar amounts shown are for the Tentatively Selected Plan which is Alternative Plan 3b. This plan would provide a 5,500-foot by 250-foot protective sand and turf beach, offshore breakwaters, a revetment, and jetties. We have previously forwarded sketches of the plans and cross sections and will be forwarding copies of the Draft Report for your review and comments in the near future.

Items 1 and 8 of Local Cooperation refer to maintenance of the project including annual nourishment. Federal participation in periodic nourishment is not recommended for the tentatively selected plan based on our current interpretation of the Office of Chief Engineer's policy as stated in the Digest of Water Resources Policies and Authorities, 27 March 1981. The Digest states that Federal participation is not recommended in periodic sand nourishment when the sand replacement is proposed as a maintenance measure accompanied by structures intended to confine the benefits of the sand within a beach compartment. This is the case at Maumee where the proposed offshore breakwaters would essentially stabilize the sand beach, resulting in minimal sand replacement, currently estimated at 5,000 cubic yards per year (or about 2 percent of the total beach volume) for the tentatively selected plan.

Exhibit 11

NCBPD-WB
Dr. Robert W. Teater, Director

Cost-Sharing Policy

The President, in his June 1978 water policy message to Congress, proposed several changes in cost-sharing for water resources projects to allow States to participate more actively in project implementation decisions and to equalize cost-sharing between structural and nonstructural flood damage prevention projects. These changes include a cash contribution from benefit States of 5 percent of the first costs of construction assigned to nonvendible project purposes and 10 percent of the first costs of construction assigned to vendible project purposes. Application of this policy to the Maumee Bay State Park project would require the State of Ohio to additionally contribute an estimated $475,000 in cash (5 percent of $9,490,000, total estimated project first costs of construction assigned to nonvendible project purposes, based on August 1981 price levels). Your views on this proposed cost-sharing policy are requested.

Items of Local Cooperation

The Items of Local Cooperation, as presented in the Draft Feasibility Report, are:

1. Provide without cost to the United States, all lands, easements, and rights-of-way, including borrow and spoil-disposal areas as determined by the Chief of Engineers, necessary for the construction and subsequent maintenance of the project. Periodic beach nourishment shall be considered as a maintenance measure;

2. Contribute in cash 30 percent of the project construction cost to be paid in a lump sum prior to initiation of construction. The estimated First Cost of construction for Plan 3b is $9,490,000 (exclusive of land costs and aids to navigation) and the non-Federal share would be $2,847,000 based on August 1981 price levels. In the event that construction is scheduled to take more than 1 year, the State contribution may be made in annual installments over the period of construction at a rate proportionate to the proposed or scheduled apportionment of Federal Funds. In either event, the final apportionment of cost will be made after actual costs have been determined.

3. Agree to provide appurtenant facilities shown on your Master Plan, for which recreational benefits have been taken, within a reasonable length of time after completion of the Corps project.

4. Hold and save the United States free from all claims for damage due to construction, operation, and maintenance of the project, except for damage due to the fault or negligence of the Government or its Contractors;

5. Provide without cost to the United States all alterations and relocations to existing improvements including highways, buildings, utilities, sewers, and other facilities which may be required because of the project;

6. Construct permanent structures and park egress roads above the 100-year water surface elevation of 577.3 IGLD and construct other park facilities considering this elevation.

7. Maintain and repair the protective and improvement measures during the useful life thereof as may be required to serve their intended purpose.

8. Pay 100 percent of the cost of periodic beach nourishment for the life of the project.

9. Control water pollution from within the park to the extent necessary to safeguard the health of the bathers;

10. Maintain continued public ownership and use of the shore upon which the amount of Federal participation is based during the economic life of the project;

11. Provide and maintain necessary access roads, parking areas, and other public use facilities open and available to all on equal items; and

12. Comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", Public Law 91-646, approved 2 January 1971, in acquiring lands, easements, and rights-of-way for construction and subsequent maintenance of the project, and inform affected persons of pertinent benefits, policies and procedures in connection with said Act.

If you have any questions or comments with the items as listed, please contact Mr. Richard Mammoser, Study Manager at (716) 876-5454, extension 2294.

Sincerely,

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

CF:
NCBPD-WB

Mammoser RM
Zorich
Gilbert
Creeden
Johnson

NCBED-PW 16 July 1981

SUBJECT: Western Lake Erie Shore, OH, Feasibility Study, Interim Report on Maumee Bay State Park Shoreline Erosion and Beach Restoration

Commander, North Central Division
ATTN: NCDPD-PF

1. The purpose of this letter is to modify our position on the subject of beach restoration at Maumee Bay State Park and obtain concurrence of higher authority. This action has been prompted by a recent review of policy on the issue of beach restoration, and more recent data.

2. Background. Maumee Bay State Park is located in Lucas County, Ohio, just east of Toledo, Ohio. Approximately 1,200 acres have recently been acquired by the Ohio Department of Natural Resources including 11,000 feet of Lake Erie shoreline. They plan on constructing a multi-use recreation complex, including facilities for camping, golfing, swimming, overnight lodging, an interpretive center, and a nature studies area. Work on the campsites and associated roadways is nearly complete, while development of the beach and related activities is contingent on Corps participation in a shoreline erosion and beach restoration project at the site. Previous use of the shoreline within the park site was rather limited, with ODNR reporting a total of 1,769 people using the area for swimming in the summer of 1979. An issue that has not been totally resolved was the extent of Federal participation in the proposed protective sand beach.

3. Current Corps Policy. Current Corps Policy is summarized in The Digest of Water Resources Policies and Authorities, EP 1165-2-1, dated 28 Sep 79. Chapter 13 entitled, BEACH EROSION CONTROL AND HURRICANE PROTECTION, paragraph b(1), reads in part as follows, "Federal participation is limited to restoration of the historic shoreline. It does not provide for Federal cost-sharing in extending a beach beyond its historic shoreline unless required for protection of upland areas." Restoration is defined as restoring lost lands rather than creation of new lands.

4. Previous Correspondence and Discussions.

a. An NCBED-PW letter dated 14 July 1980 same subject, was written by the Buffalo District (copy enclosed as Incl 1) to North Central Division. This letter requested concurrence with the District's position that the proposed protective sand beach be fully cost-shared as its construction was consistent with existing legislation. Although the letter has never been

answered, the subject was addressed at the Stage 2 Checkpoint Conference for the subject study prior to finalization of the Stage 2 Document. This Conference was held on 25 November 1980.

b. An MFR, dated 30 December 1980, was prepared documenting the results of the Checkpoint Conference. Based on discussions at this Conference, the MFR stated that the Federal Government would only participate in that portion of beach required specifically for shore protection, currently estimated at about 100 feet in width. Any width in excess of this would be ineligible for Federal participation, and thus would be a 100 percent local cost.

c. OCE, 2nd Ind to NCBED-PW letter dated 30 December 1980, Subject: Maumee Bay State Park, Ohio - Stage 2 Checkpoint Conference Memorandum for Record (MFR) MS-5 (Incl 2). This letter from the Chief, Planning Division to the North Central Division Engineer restated the criteria for Federal participation in beach construction and read in part, as follows: "Federal participation in beach construction is limited to the restoration of the historic beach, or to the minimum beach required to achieve a stable protection project, whichever is greater."

d. DAEN-CWR-R letter dated 31 July 1978, Subject: Conference on Outstanding Policy Issues to Division Engineer, New England. Copy of this letter is included as Incl 3. It restated policy as regards beach erosion control.

5. Discussion.

a. The recently completed Preliminary Feasibility Report for the subject study recommended construction of a protective sand beach, 250 feet wide. The current Stage 3 effort most likely will recommend a similar project. The historic limits of the shoreline in the project area are shown on the enclosed map (Incl 4), which was prepared by Moffat and Nichol as part of their Stage 2 effort. This map shows that the shoreline has receded a minimum of approximately 500 feet near Niles Beach and a maximum of about 1,400 feet near the western end of the park since 1877.

b. A limited beach currently exists along the shoreline of Maumee Bay, between the bluff line and edge of the water. This beach consists of a thin veneer of sand over a hard clay bottom. Although the existing beach is presently quite narrow (say 50 to 70 feet wide), it is likely that high lake levels have contributed significantly to this reduction, and as recent as 8 to 10 years ago, a beach of considerable width probably existed. Soundings taken in 1979 indicate that the slope of the shoreline is 0.5 ± percent. With this minimal slope, a reduction in the water level of only 2 feet (which has occurred in the recent past) would provide an additional beach width of 400 feet. This would be reduced somewhat by the recession of the bluff line, estimated at 12 feet/year. Even with this taken into consideration, it seems

very likely that a beach width in excess of the 250-foot width proposed in the PFR has existed within the recent, documented past, and falls inside the historic limit.

6. Conclusion. The 250-foot wide beach, as currently proposed by the District for this study, clearly falls within the historic limit of the shoreline. Furthermore, data developed since the checkpoint conference has established that a beach of greater width than that proposed recently existed. For these reasons, our position as agreed to in the MFR must be changed to one of full participation by the Federal Government.

7. We will appreciate your concurrence with our conclusions as stated above that the proposed 250-foot-wide beach at Maumee Bay State Park is eligible for full Federal participation.

4 Incl
as

GEORGE P. JOHNSON
Colonel, Corps of Engineers
Commanding

CF:
NCBED-PW

Mammoser RM
Zorich
Gilbert
Hallock
Liddell
Braun
Johnson

Dist File

NCDPD-PF (16 Jul 81) 1st Ind
SUBJECT: Western Lake Erie Shore, OH, Feasibility Study, Interim Report on Maumee Bay State Park Shoreline Erosion and Beach Restoration

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605 4 SEP 1981

TO: Cdr, USACE (DAEN-CWP-C), WASH, D. C. 20314

1. Federal participation in beach erosion control is intended "to prevent or control shore erosion caused by wind and tidal-generated waves and current" (Reference EP 1165-2-1, 27 March 1981, paragraph 13-1, b). Paragraph b(1) further states, as quoted in basic letter, that "Federal participation is limited to restoration of the historic shoreline. It does not provide for Federal cost sharing in extending a beach beyond its historic shoreline unless required for protection of upland areas.".

2. It is the interpretation of this office that the legislation does not intend to authorize restoration of land to the historic shorelines that existed, say, 100 years ago. Such authority would allow restoration of about 1400 feet of land lost since 1877 near the western end of Maumee Bay State Park. However, the authorization does intend to accomplish restoration of the historic beach width and to provide sufficient beach width for engineering purposes to achieve a stable protection project.

3. The OCE 2nd indorsement to NCB 30 December 1980 letter "Maumee Bay State Park...MS-5" appears to provide guidance that would allow Federal participation in the entire proposed 250-foot beach width which is a beach width greater than required to protect the shore from continued erosion, but apparently within the historic beach width as pointed out in the Buffalo District letter (paragraph 5). This office concurs in the guidance in OCE 2nd indorsement, although it is contrary to the agreement reached at the 25 November 1980 checkpoint conference which limited Federal participation to the width of beach required to protect the shore from continued erosion. Confirmation of this issue, or appropriate guidance is requested.

4. It is noted that a beach width less than 250 feet may ultimately be recommended. Nevertheless, this policy issue should be clarified.

FOR THE COMMANDER:

4 Incl
nc

KENNETH H. MURDOCK
Chief, Planning Division

CF:
Cdr, NCBED-PW

Exhibit 13

NCBED-PW 14 July 1980

SUBJECT: Western Lake Erie, OH, Feasibility Study-Interim Report on Maumee Bay State Park Shoreline Erosion and Beach Restoration

Division Engineer, North Central
ATTN: NCDPD-PF

1. The purpose of this letter is to request your views on and concurrence with Federal Participation in the subject project as outlined below.

2. Reference:

a. Digest of Water Resources Policies and Authorities (EP 1165-2-1), dated 28 September 1979.

b. 33-U.S. Code 426-1 as amended through 1978.

c. ER-1165-2-130, dated 15 January 1979.

d. House Document 502, 81st Congress, 2nd Session, Cleveland and Lakewood, OH, Beach Erosion Control Study, March 1948.

3. Background - Maumee Bay State Park is located in Lucas County, OH, just east of Toledo, OH. Approximately 1,241 acres have recently been acquired by the Ohio Department of Natural Resources, and they plan on constructing a multi-use recreation complex, including facilities for camping, golfing, swimming, overnight lodging, an interpretive center, and a nature studies area. Work on the camp sites and internal roadways is presently underway, while development of the beach and related activities is contingent on Corps participation in the shoreline erosion and beach restoration project at the site. Previous use of the shoreline within the park site was rather limited, with ODNR reporting a total of 1,769 people using the area for swimming in the summer of 1979. A relatively narrow beach about 50-75 feet wide presently exists, and the near shore bottom consists primarily of clay, with a thin veneer of sand and peat sometimes found on the western side of the park. It appears that the proposed plan would partially create rather than completely restore the historical beach, and it is this point that requires your comment, particularly in light of the Bureau of the Budget's comments on this subject for the Cleveland-Lakewood Beach Erosion Study (Reference d). A copy of the Bureau's comments and the Secretary of the Army's letter of transmittal to the House Speaker for the Cleveland-Lakewood Project is provided as Inclosure 1.

NCBED-PW
SUBJECT: Western Lake Erie, OH, Feasibility Study-Interim Report on Maumee Bay State Park Shoreline Erosion and Beach Restoration

4. Legislative Basis - Chapter 16 entitled "Recreation" of the Digest of Water Resources Policies and Authorities, and specifically paragraph 16-4c, refers to Beach Erosion Control and Shore Protection Projects. As stated in the Digest, beach erosion law (33 USC 426) limits Federal participation in beach erosion control projects to restoration and protection of shores and beaches. Application of this law is further defined in ER 1165-2-130.

a. Paragraph 426a of the law states in part that, "it shall be the duty of the Chief of Engineers, through the Beach Erosion Board, to make general investigations with a view to preventing erosion of the shores of the United States by waves and currents and determining the most suitable methods for the protection, restoration, and development of beaches."

b. Paragraph 6d entitled Program Policies of ER 1165-2-130 reads as follows: "Existing shore erosion control authority provides for "restoration" and "protection." It does not provide for Federal cost-sharing in extending a beach beyond its historic shoreline, unless the extension is needed for engineering reasons to provide protection from erosion."

5. Buffalo District's Interpretation of Existing Legislation - As It Applies to Maumee Bay State Park - The draft technical report for Maumee Bay which was prepared under contract by Moffatt and Nichol, was provided for your information and comments by letter dated 31 March 1980. With reference to this document, the Buffalo District is of the opinion that the beach proposed for the various alternative plans falls within the intent of applicable legislation for the following reasons.

a. The proposed beach would provide protection against shoreline erosion. The historic shoreline (shown on Inclosure 2, a map taken from the draft report) has receded a minimum of approximately 500 feet near Niles Beach and a maximum of about 1,400 feet at the western end of the park since 1877. The proposed beach has a width of 250 feet, and clearly falls within the historic limits of the shoreline. Also, the first cost of providing shoreline protection using the protective sand beach (about \$2.7 million) compares favorably with our extrapolated estimate of about \$2.6 million first cost for providing comparable shoreline protection using a rubble revetment similar to that proposed for the east side of the park. However, the annual maintenance cost for the sand beach would be considerably higher (\$120,000) than the revetment (\$7,000).

b. Although the existing beach is presently quite narrow (say 50 feet to 70 feet wide), it is likely that high lake levels over the past 8 years and also the protective structures that have been constructed updrift over the past 50 years are both partially causative of the narrow beach. It would seem that the proposed protective beach can be considered as providing some restoration, although the amount of restoration cannot be quantified.

NCBED-PW
SUBJECT: Western Lake Erie, OH, Feasibility Study-Interim Report on Maumee Bay State Park Shoreline Erosion and Beach Restoration

c. The beach, as designed, is consistent with the total park multi-recreational use concept contemplated by the Ohio Department of Natural Resources. While its width is in excess of what may be required strictly for erosion purposes, it is noted that it would serve not only for probable beach restoration and shoreline erosion control, but also would provide partial flood protection in eliminating wave runup, and as a swimming beach. Each purpose relates to one or more characteristics of the beach, but the beach is designed to satisfy all requirements.

6. Your comments and views on, and concurrence/nonconcurrence with, the District's conclusion that the Maumee Bay State Park "Shoreline Erosion-Beach Restoration Project" is consistent with existing legislation, would be appreciated.

FOR THE DISTRICT ENGINEER:

2 Incl
as

DONALD M. LIDDELL
Chief, Engineering Division

CF:
✓ NCBED-PW

Mammoser________
Zorich________
Gilbert________
Parson________
Hallock________
Liddell________

DAEN-CWP-F (30 Dec 80) 2nd Ind
SUBJECT: Maumee Bay State Park, Ohio - Stage 2 Checkpoint Conference Memorandum For Record (MFR), MS-5

DA, Office of the Chief of Engineers, Washington, DC 20314 15 APR 1981

TO: Division Engineer, North Central, ATTN: NCDPD-PF

1. To preclude any ambiguity in the application of the guidance discussed in paragraph 5 of the MFR, note that Federal participation in beach construction is limited to the restoration of the historic beach, or to the minimum beach required to achieve a stable protection project, whichever is greater. If local interests desire a beach of greater dimensions, then the additional beach beyond the historic shoreline, or properly engineered solution, would be a 100% non-Federal cost.

2. The signed MFR is returned as requested.

FOR THE CHIEF OF ENGINEERS:

8 Incl
nc

L. H. BLAKEY
Chief, Planning Division
Directorate of Civil Works

CF: w/incl:
DE, Buffalo

Exhibit 15

R.F.

DAEN-CWP-C (16 Jul 81) 2nd Ind
SUBJECT: Western Lake Erie Shore, OH, Feasibility Study, Interim Report on Maumee Bay State Park Shoreline Erosion and Beach Restoration

HQ, US Army Corps of Engineers, Washington, D. C. 20314 5 NOV 1981

TO: Commander, North Central Division ATTN: NCDPD-PF

1. You are correct in your interpretation of the guidance contained in our 2nd Indorsement.

2. Public Law 84-826 provides that shorelines may be restored to historical limits with Federal cost sharing, even though the width of beach required for a stable project may be narrower. However, projects must be economically (and environmentally) justified.

FOR THE COMMANDER:

wd all incl

L. H. BLAKEY
Chief, Planning Division
Directorate of Civil Works

CF:
Buffalo District

Exhibit 16

ODNR
Ohio Department of Natural Resources
OFFICE OF OUTDOOR RECREATION SERVICES
Fountain Square · Columbus, Ohio 43224 · (614) 466-4974

September 21, 1979

Mr. John Zorich
U.S. Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Zorich:

As was discussed in our August 29, meeting on the Maumee Bay shore erosion project, the following is our position on considering a state park as an entire unit.

The Ohio Department of Natural Resources' approach to state park development, centers on our premise that a state park is a complex entity that achieves the optimum balance between development and preservation. We also seek to achieve a balance between active and passive forms of recreation. The goal is to provide a state park facility that meets the recreational needs of the visitor while providing the highest ideals in resource management.

To achieve this goal we select and concentrate our developed facilities in areas that can accommodate intense forms of recreation. We assign no higher value to the intensely developed areas than we do to the preserved areas. We consider them at least equal in that they appeal to different, but equally important functions and compliment each other in their use.

A major aspect in determining the success of a state park is the appeal the area has to the visitor. We know that the desire of the public to utilize parks with overnight facilities is directly related to the quality of the natural features of the site as well as the variety of recreational experiences available.

For these reasons we consider a state park as an entire unit where each element contributes to the overall success of the park. We protect each element in order to assure the overall quality of the park.

Sincerely,

Donald G. Olson
Chief

DGO/jd

Exhibit 17

MOFFATT & NICHOL, ENGINEERS

CALIFORNIA · OREGON · HAWAII · MICHIGAN

September 7, 1979

Corps of Engineers
Buffalo District
1776 Niagra St.
Buffalo, NY 14207

Attn: John Zorich

Subj: DACW 49-79-C-0038

Dear Sirs:

The enclosed material briefly describes possible alternatives for Beach and Shoreline erosion and flood control at Maumee Bay State Park, Ohio. These alternatives are in the conceptual planning stage and identify a range in possible courses of action. An initial iteration workshop will be held at 1:00 p.m. on September 21, 1979 at the ODNR office in Fountain Square, Building D, Columbus, Ohio, to discuss these alternatives with the objectives of selecting at most six alternatives for further study.

It is requested that these possible alternatives be reviewed so that unacceptable alternatives can be formally identified and excluded from further studies. Additional alternative measures and combinations of alternatives should be identified for detailed study. We are looking forward to an informative and productive workshop.

Yours truly,

MOFFATT & NICHOL, ENGINEERS

AJS

Arthur Shak

AS:kr

Encl.

Copies sent to: ODNR, NOD, U.S. FISH & WILDLIFE SERVICE

... WARDLOW ROAD • LONG BEACH, CA ... • (213) ... 774-... • TELEX 65-6476

Exhibit 18

MAUMEE BAY STATE PARK
EROSION PROTECTION STUDY
POSSIBLE ALTERNATIVES

An orientation workshop was held on August 29, 1979 to discuss park development objectives and outline possible management measures to develop the park and to protect the shore from erosion. The primary objectives are to protect park land from erosion and to provide a recreational beach. The beach is planned for the west side of the park development and the east side would be retained as an interpretive nature area.

Management measures were developed for the two areas that would have different recreational uses, and both be an integral portion of the total park development. The measures considered were no federal action; a protective beach for the entire reach of shoreline; a groin field; segmented, detached breakwaters; headlands; floating breakwaters; perched beach; stone revetment; steel sheetpile bulkhead; and a dike.

The protective beach concept meets the objective for both areas. Groins, headlands and segmented detached breakwaters satisfy the objective for the west side, and may be required for the east side. Revetments, bulkheads and dikes are not satisfactory for beach development on the west side because they do not provide the recreational beach. A high bulkhead or dike are not acceptable for the east side because it would not allow continued occasional flooding of the nature area which is considered favorable for that area. The State has no desire to control water levels in the nature area. A floating breakwater would not provide adequate protection from the relatively long wave lengths and a perched beach is not applicable in the shallow waters of Maumee Bay.

The following is a brief description and preliminary evaluation of possible alternatives applicable to Maumee Bay Park. These measures will be discussed at the initial iteration workshop to select appropriate alternatives and conditions to be studied in greater detail in the subsequent study stages.

NO ACTION The no-action plan is the base condition for evaluating possible alternatives. This plan would allow shoreline recession to continue unmitigated. The planned park development would not be realized and no federal expenditure for shore protection measures would be made. The ecosystem in the area would progress naturally and possible adverse impacts associated with structural improvements would be avoided. Shore erosion throughout the study area would continue to claim State Park property and prevent the park from future development. Long term recession rates along the shoreline has been reported to be between 14.5 and 5.4 feet per year, with the west side of the park eroding at the higher rate. A weighted average rate of about seven feet per year has been observed. Continued erosion at this rate would claim approximately 80 acres of shorefront property in 50 years. This alternative does not satisfy the planning objectives.

ALTERNATIVES FOR THE NATURE AREA - EAST SIDE

Protective Beach. The protective beach concept entails construction of a medium or coarse sand beach along the shoreline. This beach would be built to an elevation high enough to prevent overtopping during high lake levels and storm waves. The width of the beach would probably be between 50 and 150 feet wide and structures may be necessary to retain sand. These structures could be groins, detached breakwaters, or headlands. Channels or conduits crossing the beach would be required to hydraulically connect wetlands with the lake. This alternative would protect the banks of the nature area and maintain a natural, aesthetically pleasing appearance. Periodic nourishment would be required to maintain the protective beach. High maintenance costs may be required to retain an adequate beach. A high beach berm along the perimeter of the nature area may increase the flood hazard by ponding water.

Sheet Pile Sea Wall. A steel sheet pile seawall constructed along the shoreline would provide protection to the nature area. The top elevation of the seawall could be designed to allow wave overtopping and some erosion of the wetland area providing habitat diversity. The structure would require a backfill with tie backs to resist soil, ice and wave forces. The structure would have a long structural life, and be relatively maintenance free.

DIKE. A protective dike similar to the structure enclosing the Cedar Point National Wildlife Refuge could be extended to protect the nature area from erosion. This dike is an earth filled mound faced with armor stone on the lake ward side. The top elevation of the dikes would be approximately 15 feet above LWD and would not allow any significant wave overtopping. Channels, or conduits, with flood control gates would be necessary to control wetland water levels in the nature area. This dike would stop wave induced erosion in the nature area. It would be a permanent structure and relatively maintenance free. An objection to a high dike or any other structure which completely blocks wave energy from the nature area is that such a structure may decrease the degree of habitat diversity and reduce the interpretive value of the nature area.

Low Height Revetment. A low height revetment with crest elevation at about six feet above LWD protected by armor stone would allow some wave overtopping during high lake levels. This would protect the shoreline but not control water levels in the nature area. This would provide habitat diversity. As with other alternatives, drainage channels or conduits would be provided.

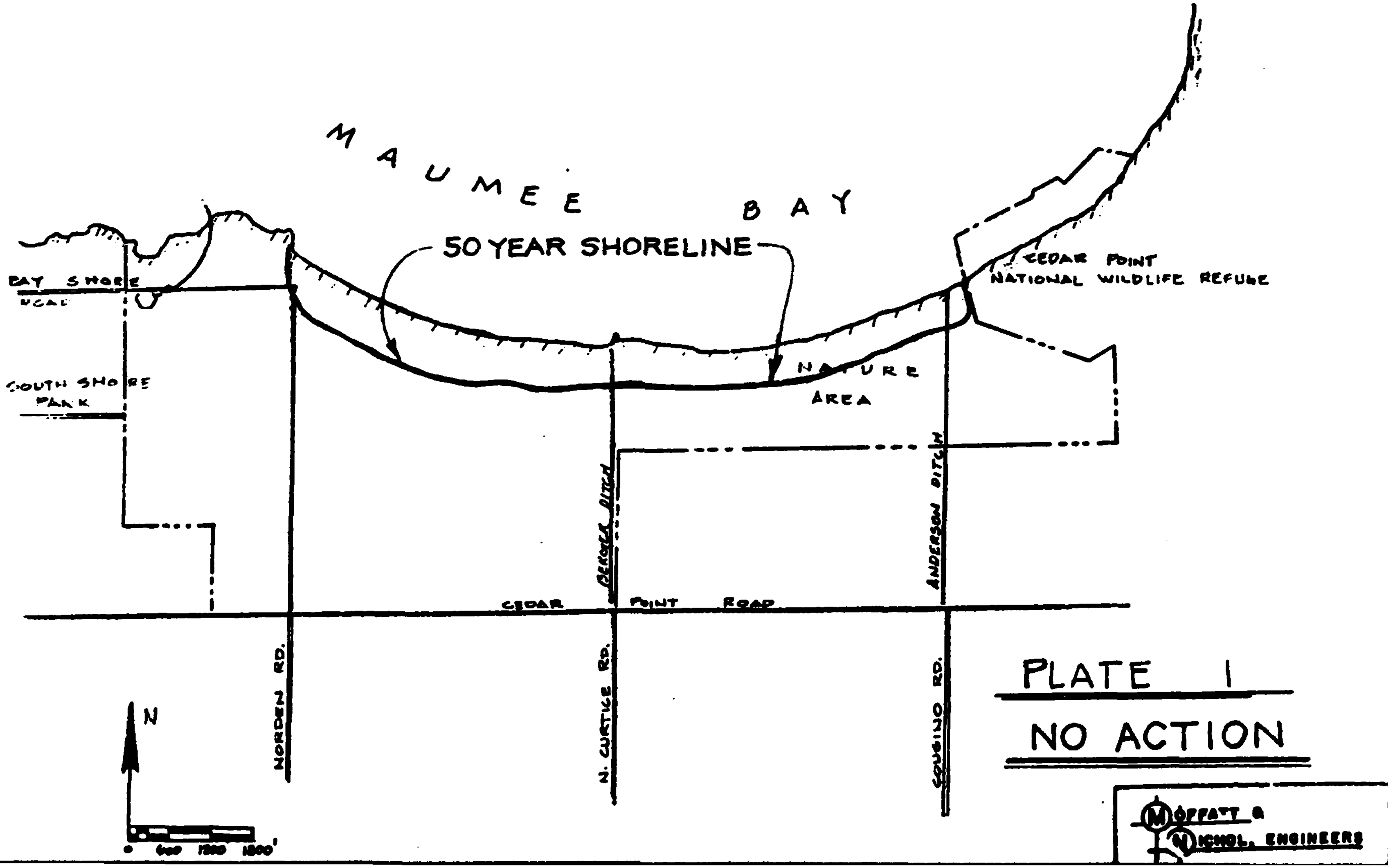
ALTERNATIVES FOR THE WEST SIDE

Protective Beach. A protective beach wide enough to absorb fluctuations in the shoreline and high enough to prevent wave overtopping during high lake levels is the preferred local plan. It meets the master plan objectives of mitigating further shoreline erosion and creating a recreational beach for the park development. The beach could be stabilized with renourishment or by structural devices to retain the beach including groins, detached breakwaters, or headlands.

Groins constructed by driving steel sheet pile, concrete sheet pile or by placing stones would allow a sandy shoreline to become oriented with the incident wave climate to reduce longshore sand movement. Objections to the use of groins are that it is uncertain, at this stage, whether it would be effective in retaining the beach. The width of beach would typically be 50 feet on the downdrift side of the groin to about 150 feet on the updrift side.

NONSTRUCTURAL ALTERNATIVES

Alternatives such as evacuation planning, modification of building codes, or regulation of flood plain development are nonstructural measures which could be applied to mitigate flood damage in the Maumee Bay State Park. These measures, however, would do nothing to lessen the shoreline erosion problem; and hence would prevent a future improvements of the Maumee Bay State Park.


MAUMEE BAY
50 YEAR SHORELINE
CEDAR POINT
NATIONAL WILDLIFE REFUGE
NATURE AREA
BAY SHORE ROAD
SOUTH SHORE PARK
CEDAR POINT ROAD
NORDEN RD.
N. CURTICE RD.
COUSINO RD.
ANDERSON DITCH
N
0 600 1200 1800'
PLATE 1
NO ACTION
MOFFATT & NICHOL, ENGINEERS

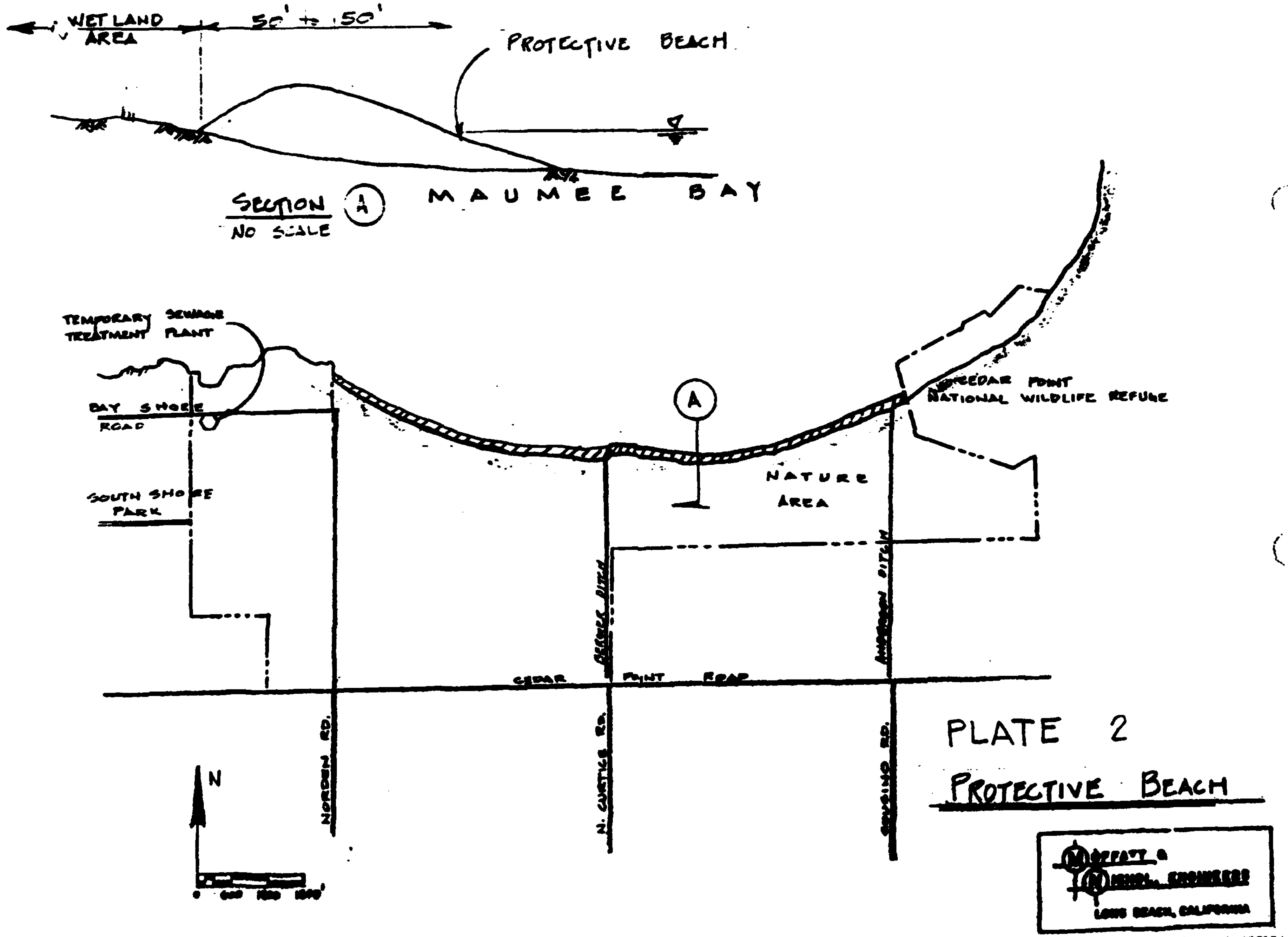
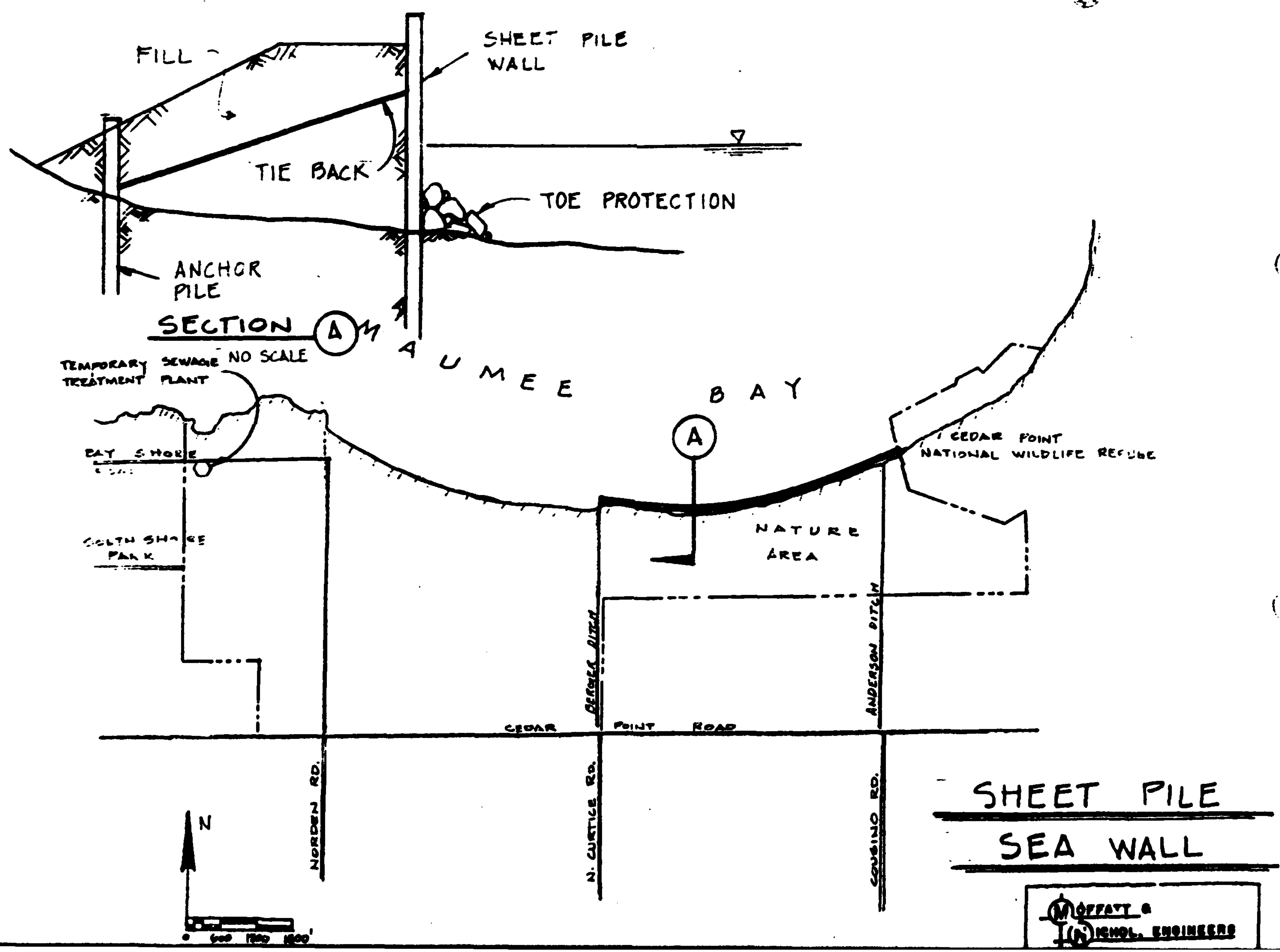
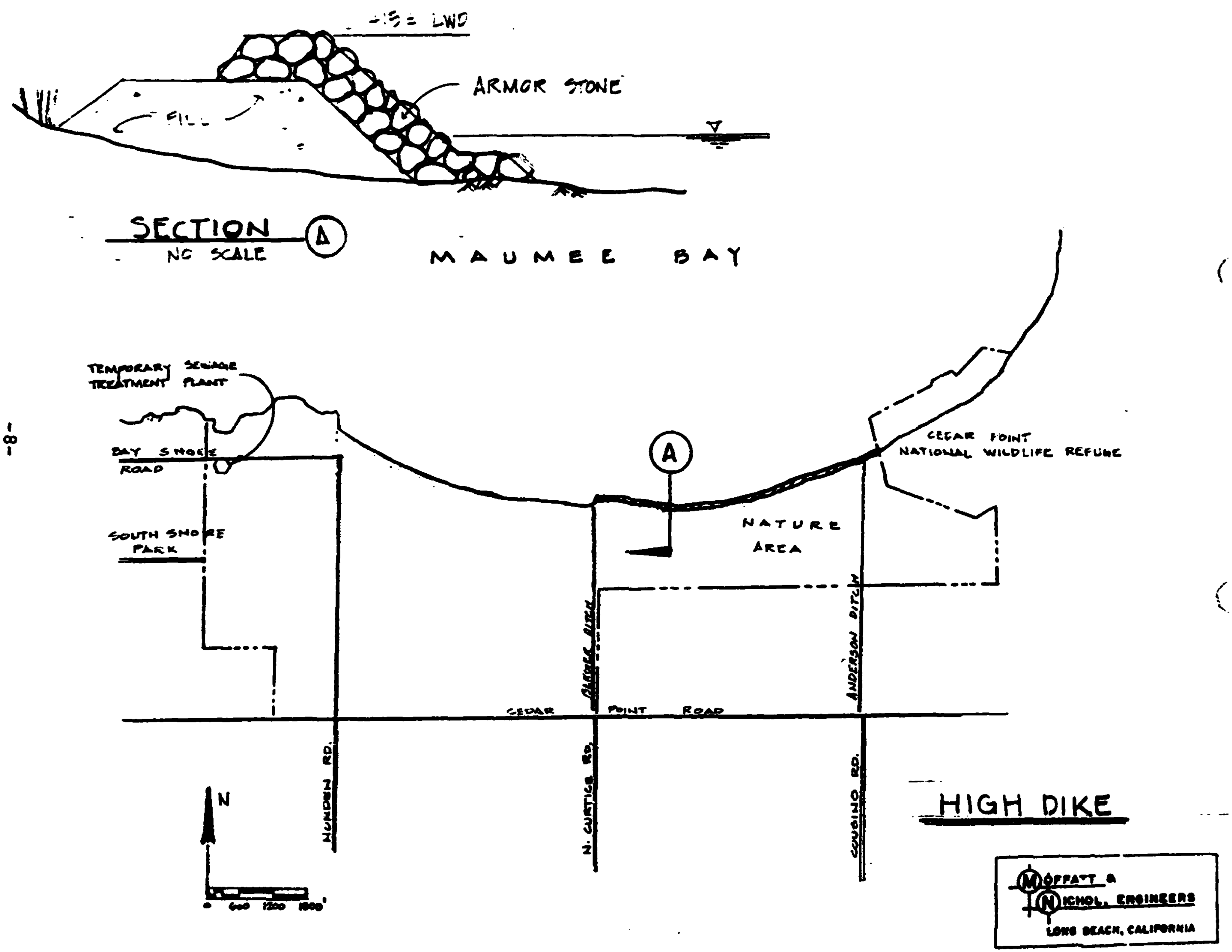


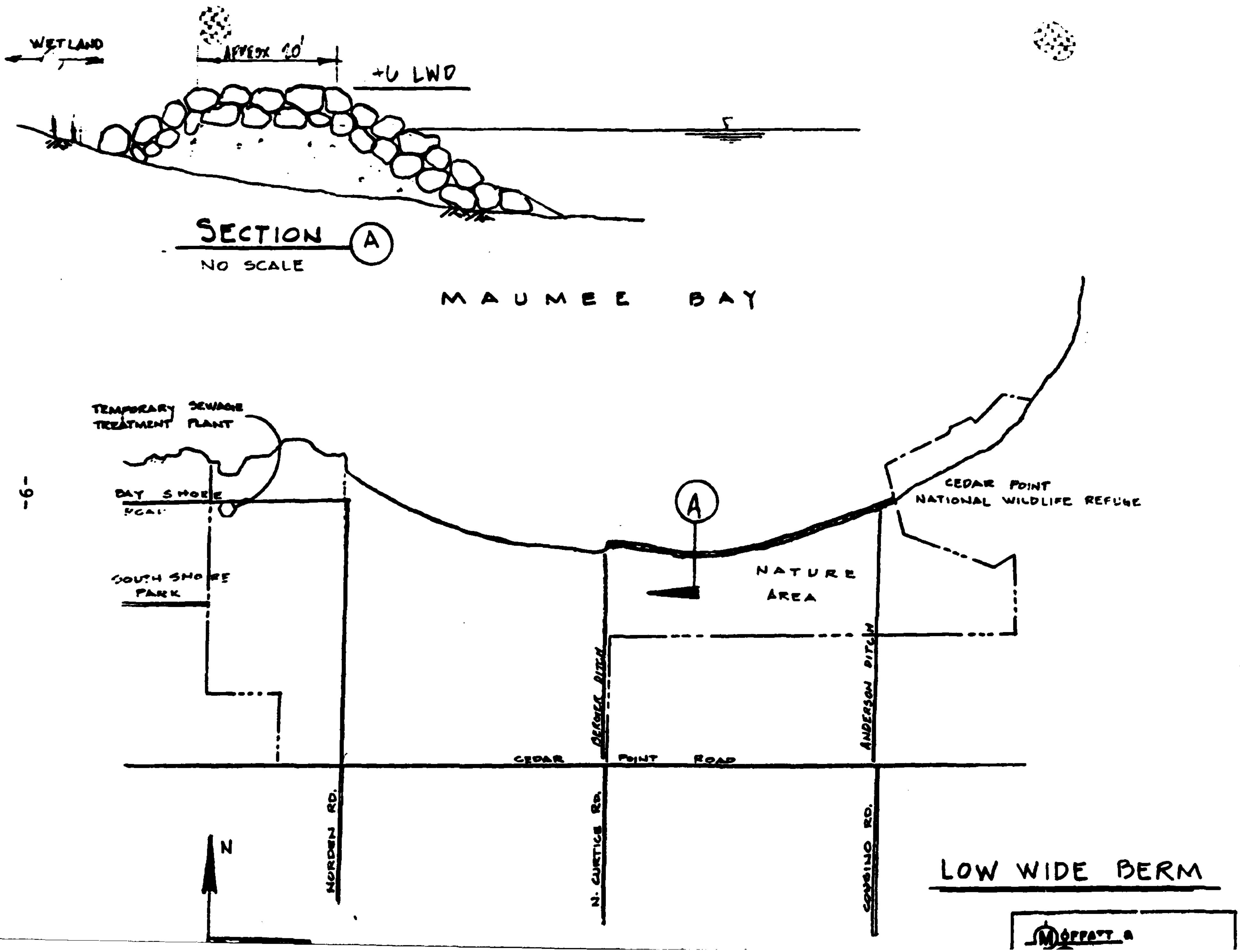
PLATE 2
PROTECTIVE BEACH

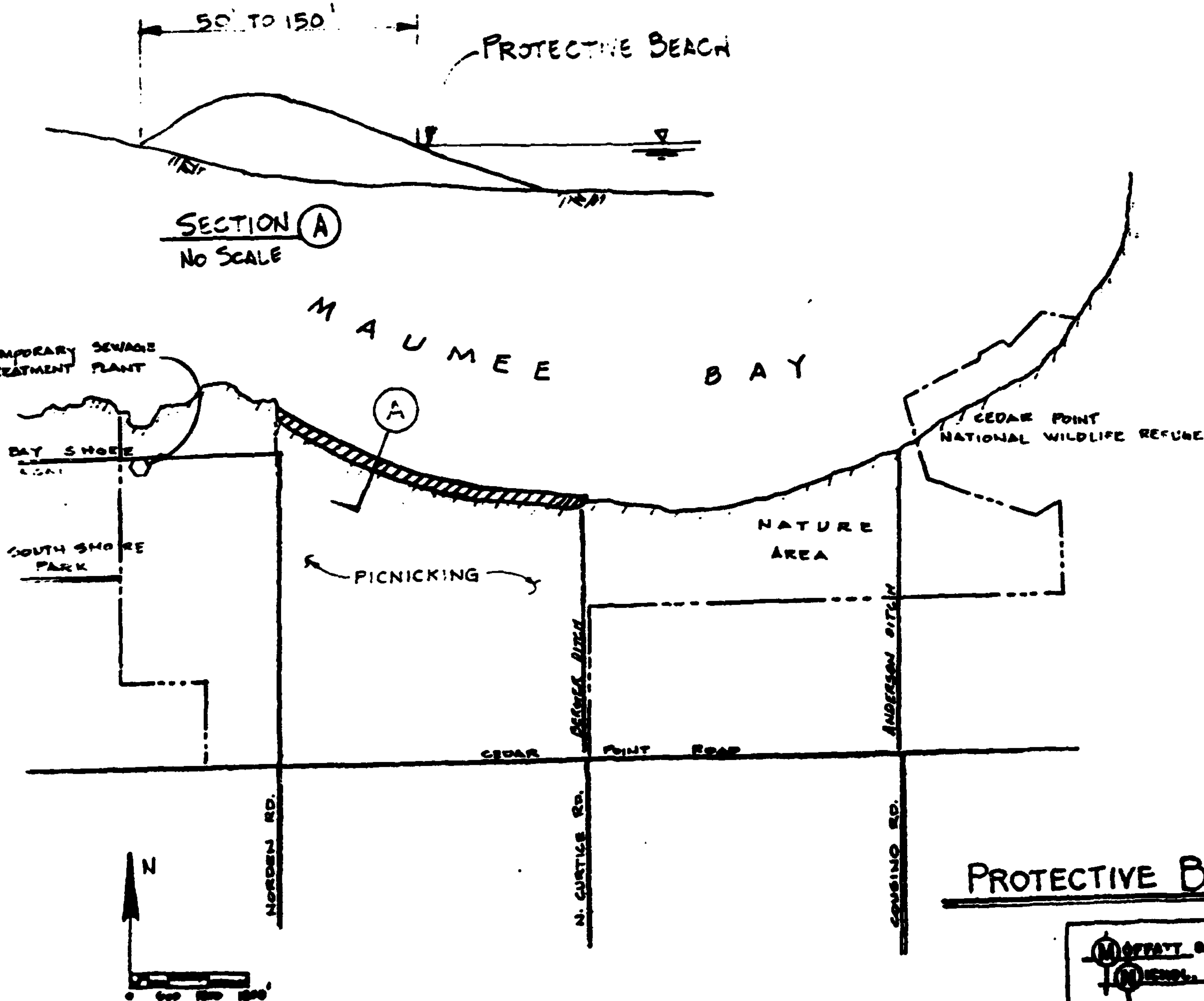


FILL
SHEET PILE WALL
TIE BACK
TOE PROTECTION
ANCHOR PILE
SECTION A
NO SCALE
MAUMEE BAY
A
TEMPORARY SEWAGE TREATMENT PLANT
BAY SHORE
NATURE AREA
CEDAR POINT NATIONAL WILDLIFE REFUGE
BERGER DITCH
ANDERSON DITCH
CEDAR POINT ROAD
NORDEN RD.
N. CURTICE RD.
COUSINO RD.
N
0 600 1200 1800
SHEET PILE
SEA WALL
MOFFATT & NICHOL, ENGINEERS



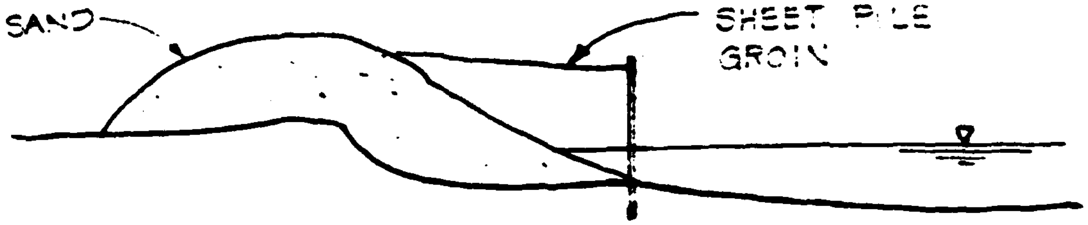
LWD
ARMOR STONE
FILL
SECTION A
NO SCALE
MAUMEE BAY
TEMPORARY SEWAGE TREATMENT PLANT
BAY SHORE ROAD
SOUTH SHORE PARK
A
NATURE AREA
CEDAR POINT NATIONAL WILDLIFE REFUGE
ANDERSON DITCH
CEDAR POINT ROAD
HUMDEN RD.
N. CURTICE RD.
COUSINO RD.
N
0 600 1200 1800'
HIGH DIKE
MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA


WETLAND
APPROX 40'
+6 LWD
SECTION A
NO SCALE
MAUMEE BAY
TEMPORARY SEWAGE TREATMENT PLANT
BAY SHORE ROAD
SOUTH SHORE PARK
A
NATURE AREA
CEDAR POINT NATIONAL WILDLIFE REFUGE
DECKER DITCH
ANDERSON DITCH
CEDAR POINT ROAD
NORDEN RD.
N. CURTICE RD.
COUSINO RD.
N
LOW WIDE BERM

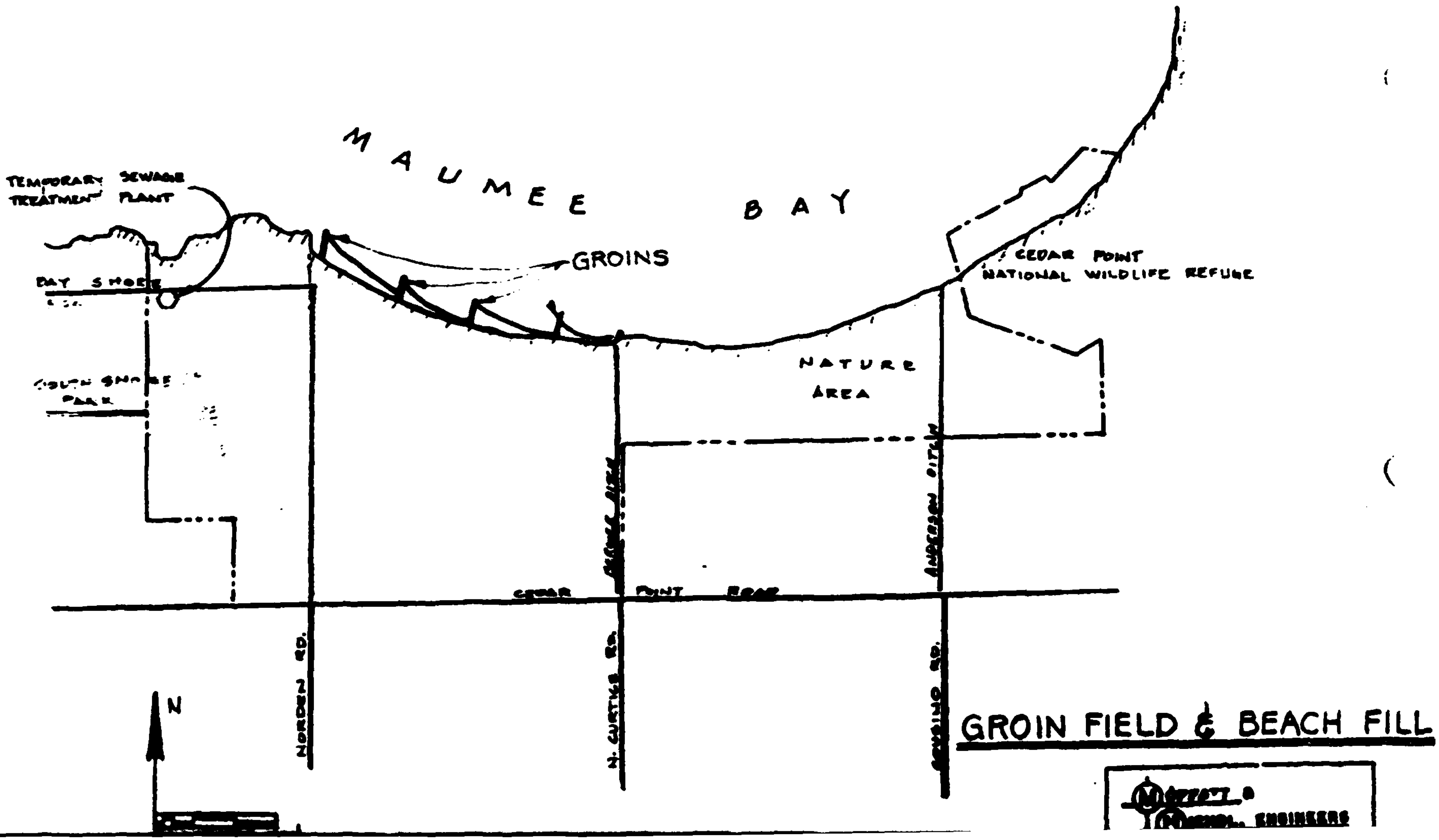


PROTECTIVE BEACH

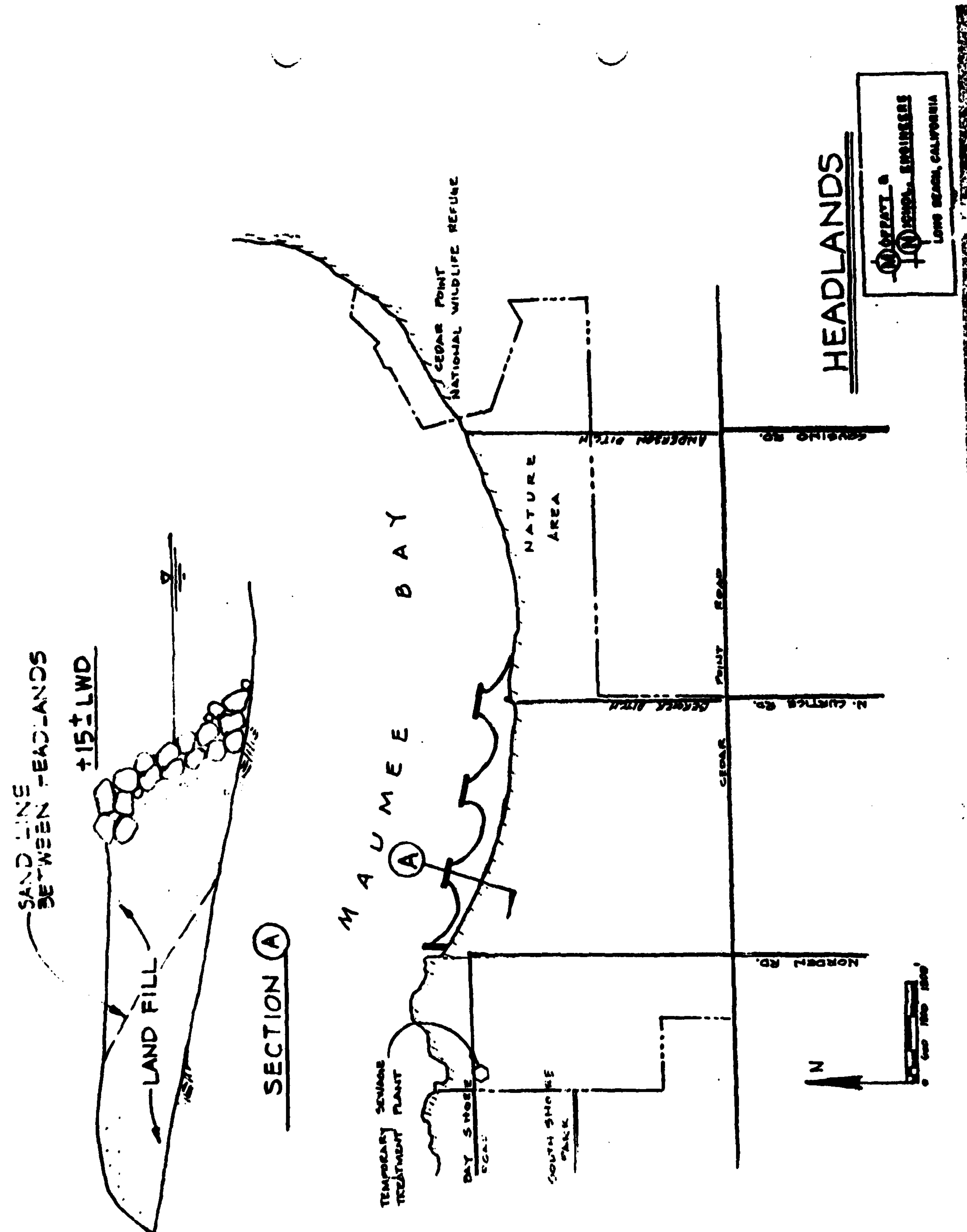
MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA



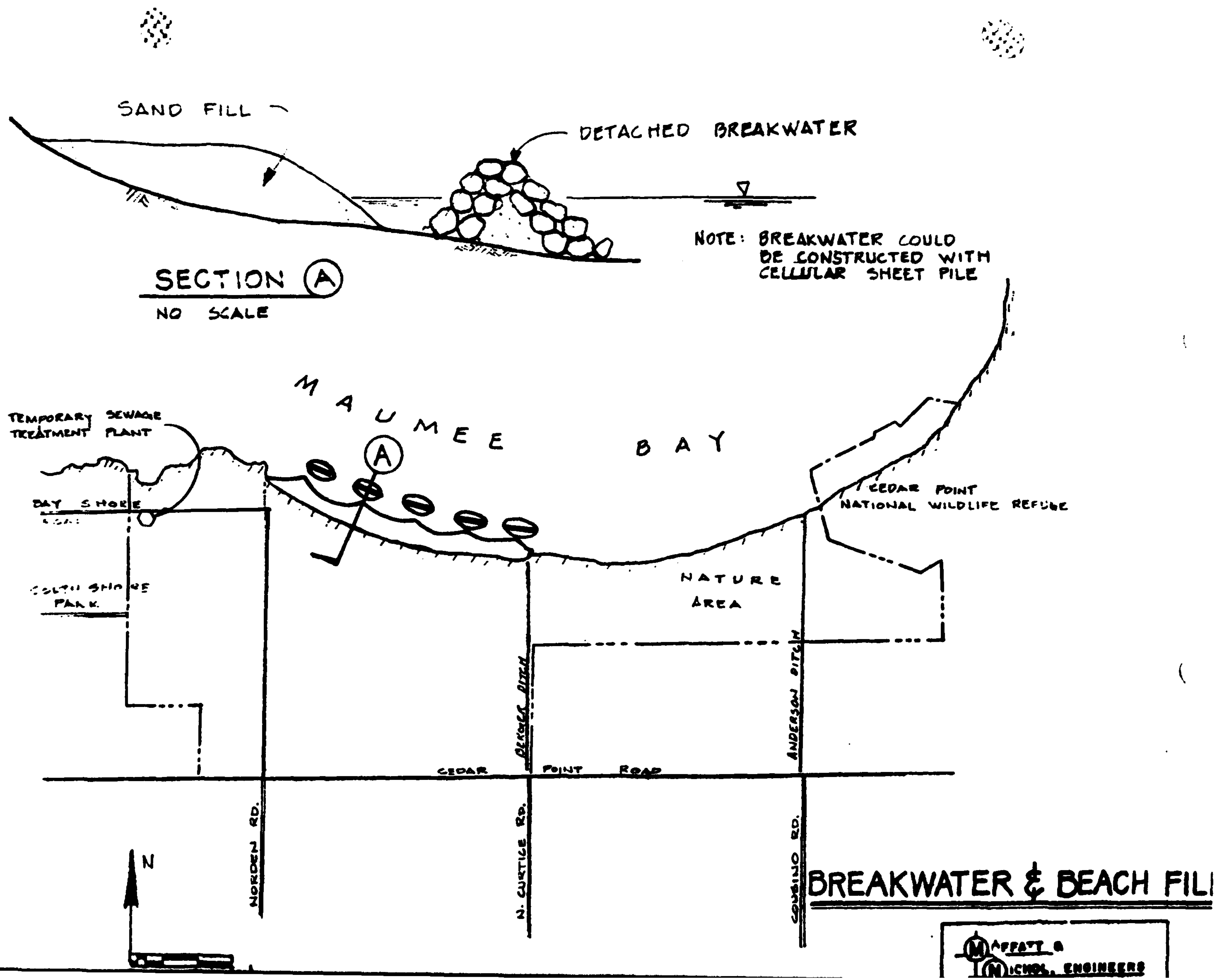
SECTION (A)



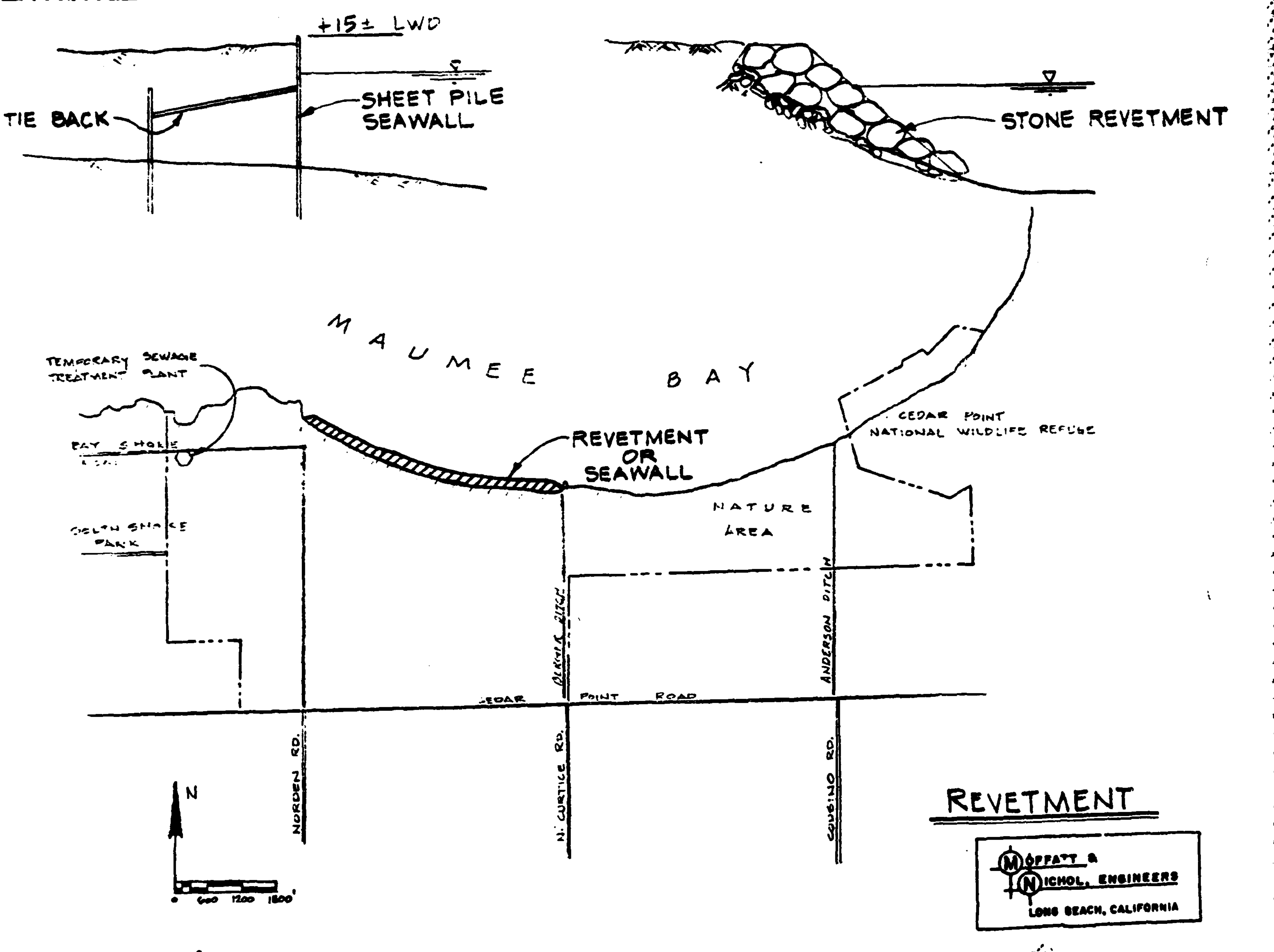
GROIN FIELD & BEACH FILL



SAND LINE BETWEEN HEADLANDS
+15± LWD
LAND FILL
SECTION A
MAUMEE BAY
A
TEMPORARY SEWAGE TREATMENT PLANT
BAY SHORE ROAD
SOUTH SHORE PARK
NORDEN RD.
CEDAR POINT ROAD
N. CURTICE RD.
NATURE AREA
ANDERSON DITCH
CEDAR POINT NATIONAL WILDLIFE REFUGE
N
HEADLANDS
MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA



BREAKWATER & BEACH FIL


+15± LWD
TIE BACK
SHEET PILE SEAWALL
STONE REVETMENT
MAUMEE BAY
TEMPORARY SEWAGE TREATMENT PLANT
REVETMENT OR SEAWALL
CEDAR POINT NATIONAL WILDLIFE REFUGE
NATURE AREA
ANDERSON DITCH
CEDAR POINT ROAD
NORDEN RD.
N. CURTICE RD.
COUSINO RD.
N
0 600 1200 1800
REVETMENT
MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA

MOFFATT & NICHOL, ENGINEERS

CALIFORNIA · OREGON · HAWAII · MICHIGAN

September 25, 1979

U.S. Army Corps of Engineers
1776 Niagra Street
Buffalo, New York 14207

Attn: Program Development Office

Subject: Progress Report 2
DACW 49-79-C-0038
Work Order No. 1
Our Job L-1834

Dear Sir:

This is our second monthly progress report on the above referenced contract for the Maumee Bay State Park Study. Since the last progress report, we have conducted a site visit, on the orientation workshop (8/29/79) and the initial iteration workshop (9/21/79). We were proceeding on schedule up to the date of the initial iteration workshop, reviewing available data, preparing and submitting conceptual plans, and collecting information to establish existing conditions. Unfortunately, we were unable to select specific alternatives for further study at the initial iteration workshop and hence, cannot proceed with preliminary designs, cost estimates and economic evaluation of alternatives. We are therefore proceeding with the wave and littoral drift analysis, and preparation of the draft report for sections B (Resources and Economy) and C (Problems and Needs).

We hope that a policy decision by the Corps of Engineers on the economic evaluation of alternatives will allow a consensus between ODNR and the Corps on alternatives selected for further study. In the interim, we will continue to work on the items mentioned above.

Contact was made with David Hanselman from ODNR Coastal Zone Management to determine the bearing of the proposed program on design criteria for Maumee Bay State Park. The program will designate Maumee Bay State Park as a special management area and generally recommends development which is consistent with ODNR's master plan.

P. O. BOX 7707 • 250 WEST WARDLOW ROAD • LONG BEACH, CA • 90807 • (213) 426-9551, 774-5650 • TELEX 65-6476

Enclosed are minutes of the initial iteration workshop held at ODNR on September 21, 1979.

Very truly yours,

MOFFATT & NICHOL, ENGINEERS

James R. Walker

James R. Walker

JRW:kr

Encl.

Ref: Our L-1834
DACW 49-79-C-0038
Maumee Bay State Park Erosion Protection

September 21, 1979

INITIAL ITERATION WORKSHOP - MINUTES

An initial iteration workshop was held September 21, 1979, at the ODNR office, Fountain Square, Building D, Columbus, Ohio.

Persons present are shown on the attached sheet.

John Zorich (C. of E.) gave an overview of the study process and the orientation workshop held previously on August 29, 1979.

Kimo Walker (M&N) discussed possible alternatives that Moffatt & Nichol had provided in letters to the persons present, dated September 7, 1979. Explained that objective of this meeting was to eliminate alternatives which would be unacceptable from further study.

James Swartzmiller (ODNR) explained that the present method of showing alternatives with different types of erosion protection for the west and east sides of the park is not acceptable. Dividing the park into passive use on the east side and active usage (high usage) on the west side, would cause the two sides to be treated separately in the economic evaluation and not as one entity. Prefers to see one type of erosion protection along the entire shoreline of the park. Acknowledges that a beach is desired for the western end of the park, but does not want to eliminate the evaluation of rubble revetment or bulkhead alternatives along this reach on that basis.

John Zorich (C. of E.) mentioned that Corps policy may require that the project be evaluated on an incremental basis, but that they are approaching the study with an open mind.

James Swartzmiller (ODNR) mentioned that the temporary sewage treatment plant shown on ODNR's park master plan does not exist. At Crane Creek, the State of Ohio had to pay for protecting the wildlife area which he considers more valuable to the people of Ohio than a recreational beach.

No decisions could be made on alternatives which could be eliminated from further study except the headlands concept, which was eliminated on the basis that it may create a potential safety hazard for children.
Fish & Wildlife expressed that rubble mound structures would be preferable to vertical sheetpile type structures if economically feasible.

It was decided that the Corps of Engineers would make a policy decision on how to evaluate benefits of the passive vs. the active portion (proposed) of the park before alternatives for further study could be selected. Moffatt & Nichol would proceed with the littoral drift analysis and background write-up for the feasibility report.

MAUMEE BAY STATE PARK
FEASIBILITY STUDY
INITIAL ITERATION WORKSHOP
FRIDAY, 21 SEPTEMBER 1979

Name	Title	Organization
Bob Lucas	Governmental Agency Coordinator	ODNR
John Zorich	Chief, Western Basin	Corps of Engineers
Arthur Shak	Coastal Engineer	Moffatt & Nichol
David Hanselmann	Planner	ODNR - CZM
Mary Ellen Rusnor	Biologist	U.S. Fish & Wildlife Service
Diana Hwang	Biologist	U.S. Fish & Wildlife Service
Tony Eelman	Project Manager	Corps of Engineers
Kimo Walker	Moffatt & Nichol	
Wayne Warren	Outdoor Recreation	ODNR
Roger Hubbell	Asst. Chief - Office of Outdoor Recreation Services	ODNR
James Swartzmiller	Chief Engineer	ODNR

NCBED-PW 9 October 1979

SUBJECT: Western Lake Erie, OH Feasibility Study - Interim Report on Maumee Bay State Park Shoreline Erosion

Division Engineer, North Central
ATTN: NCDPD

1. The purpose of this letter is to request your views on our proposed approach for evaluating project benefits for the subject interim report as outlined below.

2. Background - Maumee Bay State Park is located in Lucas County, OH (See Inclosure 1). The Ohio Department of Natural Resources' (ODNR) proposed development plan calls for constructing a multi-use recreation complex including facilities for camping, golfing, swimming, overnight lodging, an interpretive center, and nature studies on this 1,300-acre site (*See Inclosure 2*). Work on the camp sites was started this year. ODNR desires protection for the 10,000 feet of park shoreline prior to or concurrent with development of those park facilities that would be adversely affected by continued shoreline erosion, such as swimming, beach, nature areas, and lodge complex. The purpose of the Maumee Bay feasibility study is to determine the Federal interest in providing shoreline protection for the park complex.

3. ODNR's Position on Benefit Evaluation - ODNR's projection for annual park attendance is slightly over 1 million persons as shown in Inclosure 3. Our interpretation of the State's position is that they consider all features of the park to be integrally dependent and requiring shoreline protection over the entire 10,000 feet of shoreline in order to realize ultimate utilization of the complex. On this basis, ODNR feels that the entire 1 million annual visitors (assuming this projection is correct) should be used in determining annual recreational benefits for a Federally-constructed shoreline protection project at the park. Inclosure 4 is a 21 September 1979 letter from ODNR outlining their rationale.

Exhibit 20

NCBED-PW
SUBJECT: Western Lake Erie, OH Feasibility Study - Interim Report on Maumee Bay State Park Shoreline Erosion

4. Buffalo District's Position on Benefit Evaluation - We agree with ODNR that the functional integrity of the park would be destroyed and optimum potential for utilization would not be realized if the entire park shoreline is not protected. Also, it is improbable that a multi-use recreational complex would, or should, be developed without shoreline protection. However, we believe that the acceptable Corps practice would preclude using total annual park attendance (1 million annual visitations in the case of Maumee Bay State Park) in establishing annual recreation benefits. Rather, our approach to shoreline protection would be to identify specific water-dependent and water-enhanced recreation activities that could be adversely affected, - i.e., swimming, shoreline erosion, flood damage reduction, land enhancement, etc. - and use our standard methods to obtain average annual damages and benefits stemming from improvement proposals. Based on our conclusion that shoreline protection along the entire 10,000 feet of park shoreline must be an integral feature of the park if it is to be developed as a multi-use recreational complex, the annual benefits derived would be used in evaluating economic justification for protection of the entire 10,000 feet of shoreline irrespective of the type of protection provided. For example, ODNR's plan calls for a restored beach for about half of the westerly shoreline, a nature area to the east. It is likely that different types of shore protection structures would be appropriate for these two reaches. In this case, we would base our economic evaluation on total cost for protecting the entire shoreline and total water-related and water-enhanced benefits derived for the entire park complex. We feel that this approach is consistent because development of the park complex is contingent upon the entire shoreline being protected.

5. Your timely response on this matter is appreciated.

FOR THE DISTRICT ENGINEER:

4 Incl
as

KENNETH R. HALLOCK
Acting Chief, Engineering Division

RECEIVED
OCT 15 1979
MOFFATT & NICHOL ENGINEERS

REFER TO	
R.D.N.	
J.M.N.	
J.T.G.	
W.S.	
M.R.M.	
R.G.C.	✓
Kim	

NCDPD-PF(9 Oct 79) 1st Ind
SUBJECT: Western Lake Erie, OH Feasibility Study - Interim Report on Maumee Bay State Park Shoreline Erosion

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, IL 60605

TO: District Engineer, Buffalo

The proposed approach for evaluating project benefits is generally concurred in. Comments of the NCD economics branch are inclosed. The recreational benefits should be the difference between the with (shore protection) and without (shore protection) conditions. The water dependent and water enhanced recreational activities must be identified and evaluated as well as the loss of land and damage or loss of buildings. Environmental impacts must be identified and NED and EQ plan developed.

FOR THE DIVISION ENGINEER:

1 Incl
1-4 wd
Added 5

KENNETH H. MURDOCK, P.E.
Chief, Planning Division

FACSIMILE HEADER SHEET
(BR 105-1-4)

FROM (Name)	OFFICE SYMBOL	TELEPHONE NO.	RELEASER SIGNATURE		
C. LARSEN	NCD PD-PF	8-886-6467	Charles W. Larsen		
TO (Name)	OFFICE SYMBOL	TELEPHONE NO.	# PAGES	PRECEDENCE	
T. EGLMAN	NCBPD	8-473-2244	2	PRIORITY	

SUBJECT

Exhibit 21

MOFFATT & NICHOL, ENGINEERS

CALIFORNIA · OREGON · HAWAII · MICHIGAN

November 16, 1979

Mr. Donald G. Olson
Ohio Department of Natural Resources
Office of Outdoor Recreation Services
Fountain Square
Columbus, Ohio 43224

Dear Sir:

Enclosed is our preliminary analysis of possible solutions presented at workshops held at ODNR on August 29, 1979 and September 21, 1979 on the Maumee Bay shore erosion study. In this analysis, solutions which we feel are unacceptable, economically or in meeting park planning objectives, have been screened. We suggest that alternative development and selection for further study can be made through this letter in lieu of another workshop. Six alternative concepts have been developed as being the most promising and are presented in sketch form. We suggest that these alternatives be carried forward through preliminary design and cost estimates. We request your review and concurrence of these alternatives. The protective beach and revetment alternative has two variations, one which we would like to eliminate from further consideration.

If the alternatives suggested are not acceptable, please advise us as soon as possible as to the problems so that discussion and/or meeting arrangements can be made. The no-action plan, alternative 1, is required by the Corps planning process. For the economic analysis of other alternatives, the incremental benefits over the no-action alternative will be weighed against the total cost of federal involvement. To estimate the incremental benefits, a reasonable park development plan and patronage will have to be adopted under the no federal action alternative. We request your input on what further park development could be expected with no federal shore protection and any information which may be helpful in establishing a rationale for assessing recreational value of different levels of park development.

Very truly yours,

MOFFATT & NICHOL, ENGINEERS

JRW

James R. Walker

JRW:kr

cc: U.S. Fish & Game
Buffalo C of E
NCD C of E

P. O. BOX 7707 • 250 WEST WARDLOW ROAD • LONG BEACH, CA • 90807 • (213) 426-9551, 774-5650 • TELEX 65-6476

Exhibit 22

16 November 19

MAUMEE BAY STATE PARK

EROSION PROTECTION STUDY

ALTERNATIVE DEVELOPMENT

Workshop meetings were conducted at ODNR offices on August 29 and September 21, in 1979 to determine the state's desires for improvements and to ascertain their comments on preliminary management measures. The state plans to construct a recreational waterfront park for multiple uses. Each use is an integral part of the total park concept. The primary uses are:

Overnight camping

Day-Use, picknicking, swimming

Golf course

Lodge and cabins

Interpretive nature areas

The reach of shoreline is approximately 10,000 feet long and is experiencing a long-term recession rate of about 13 feet per year. The shoreline is primarily a low clay bluff with traces of sand on a small beach which has very limited opportunity for bathing. Part of the shoreline has remnants of a housing development whose shoreline has been protected by concrete rubble. The remaining reach is low-lying forested land. The state desires to develop the area in the most efficient way by protecting the entire reach of shoreline to enable the park concept to develop to its full potential while providing a swimming beach to improve the recreational value of the park development.

Littoral transport studies by Moffatt & Nichol indicate that the potential for littoral drift along the present shore alinement is on the order of 50,000 cubic yards per year to the west. This potential has not been met due to a lack of sand. If a beach were oriented to face toward the east, the potential for longshore movement would be reduced substantially. The west side of the park has this general orientation and would be the most suitable place to install the beach. This is also the area ODNR envisioned for the beach. A properly designed and maintained beach should prevent erosion and provide the desired swimming opportunities. The remaining shoreline reaches also require protection to mitigate erosion and permit full development of the park. Therefore, a primary criterion adopted in this study is to protect all reaches of the shoreline, while providing a recreational beach within the western half of the park.

Several management measures were discussed at the workshops. Although none were definitely screened from further consideration, some comments were made that have led us to perform the necessary screening to keep the project on schedule. The following discussion provides rational for screening and development of alternatives. An additional workshop may be required if the selected alternatives are not acceptable to ODNR.

No Action. Study of this alternative is required to define a baseline framework. If no federal action is taken, the park land will continue to erode and it will not be able to develop to its full potential. No beach will be provided and much of the area set aside for preservation and interpretive nature areas will be lost. Land will remain for camping, the cabins and lodge and golf course for a 50 year design life, but these activities would not develop or attract patronage as they would if shore protection and a beach were provided. It is not possible to determine an accurate differential in patronage with and without shore protection, but some rationale will have to be developed in the benefit analysis to justify the cost of federal involvement.

Headlands. Shoreline stabilization can be achieved by aligning the shore normal to the incident waves resulting in zero net littoral transport. One method is to build headlands. A headland was ruled out as a desirable feature by ODNR because of possible hazzard to swimmers created by scour along the lakeward side of the structure. Construction of headlands also require large quantities of landfill and would probably not be cost effective. Based on this, a series of headlands along the shoreline was ruled out as a feasible measure.

Protective beach. A protective beach built with imported sand could protect all reaches of the shoreline. Periodic maintenance would be required to redistribute sand that erodes from one area and accumulates in another and to replace sand lost to the offshore. The berm elevation should be above normal wave runup. A barrier dune should be provided to prevent flooding that would carry the beach sand inland. The dune should be vegetated to reduce sand loss by wind. An alternative to a barrier dune is a wall. Another concept would be to build the beach berm to the elevation of the existing ground, however, this is not as desirable due to the potential inland transport of sand. Introduction of large amounts of sand to the area would cause shoaling problems in the drainage ditches. Structures would have to be constructed to maintain the ditches free of beach sand.

Groins. Longshore littoral transport can be controlled by constructing a groin field. This is a feasible solution and should be carried forward. The groins could be stone, steel sheet pile, concrete sheet pile or wooden. A stone groin is preferred over sheet pile groins by the U.S. Fish and Wildlife Service, as it would provide a more desirable habitat. A stone groin field should be cost effective and will be further developed. The groin field would be filled with sand and maintained by periodic resupply.

Detatched Breakwaters. Segmented, detatched breakwaters are a relatively new concept, but have worked at Lakeview Park in Lorain, Ohio to retain a beach fill. The principle is to regulate incident wave energy along the Beach and reduce offshore sand losses. They may be applicable to Maumee Bay State Park and therefore, will be carried forward as an alternative.

Floating Breakwater. Floating breakwaters reduce wave energy approaching the shore, however, they are only partially effective for the relatively long period waves of approaching the park shoreline and have been screened from further consideration.

Revetment. Niles beach has been protected by a concrete rubble revetment for about 40 years. The revetment is slowly deteriorating by flanking and possibly due to a lack of adequate filter material and undersized armor units. The revetment is overtopped, but has provided adequate protection. A rubble mound revetment fronting Niles beach and the areas not protected by the beach should provide adequate erosion protection, however, not flood protection. This concept will be carried forward. An alternative to rubble construction would be a steel sheet pile bulkhead, however, this is not considered as feasible economically, aesthetically or environmentally in the nature area. Therefore, a sheet pile bulkhead should be screened from further consideration at this level of study.

Dike. The Cedar Point National Wildlife Refuge east of the project site is protected by a 15 foot (LWD) high stone-armored dike. The water levels within the area are controlled by gates and pumps. ODNR and U.S. Fish & Wildlife have stated that there is no desire to control water levels or prevent flooding in the nature area. In fact, some flooding would be desirable for the nature area to promote habitat of diversity. Consequently, the high dike has been screened in lieu of a revetment which provides the required protection at lower cost with more desirable impacts.

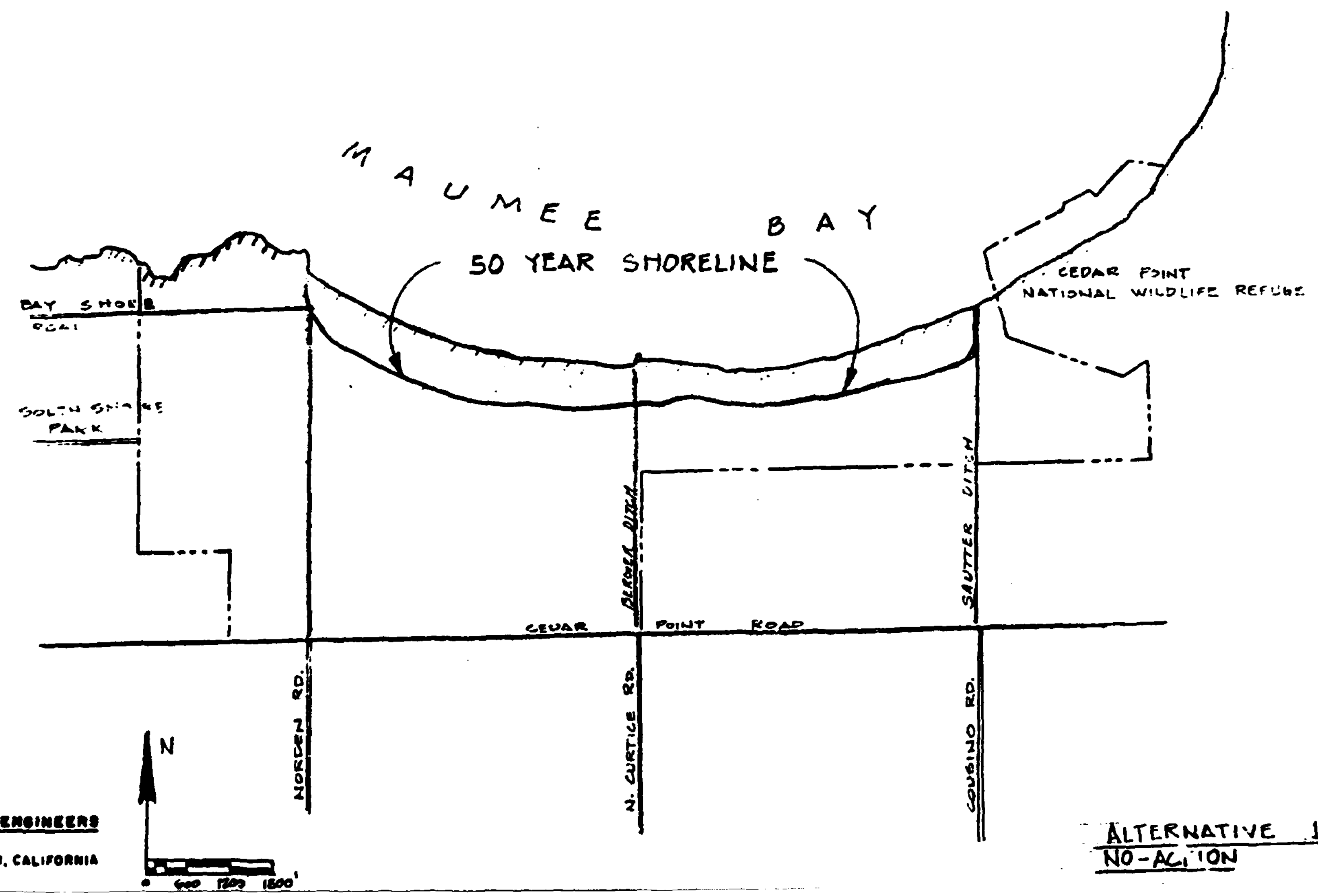
Perched Beach. A perched beach, or sill placed offshore, is an unproven concept that is applicable to steeper gradient beaches. This concept is not applicable to this site.

Non-structural measures. Flood proofing, evacuation planning and regulation of flood plain development are non-structural alternatives that could be employed to mitigate flood and erosion damages to existing and future structures. These alternatives, however, would not mitigate the loss of park land and would prevent the park from developing into a multiuse facility. These non-structural measures have therefore been eliminated from furthur study. Lake level regulation is one non-structural measure which could reduce erosion rates and flooding. Benefits accruing in the study area could be estimated, but could not support a lake regulation plan. The International Lake Erie Regulation Study is examining the feasibility of limited regulation of Lake Erie. Lake level regulation is not considered a viable alternative for the Maumee Bay State Park study.

The screening process leaves a protective beach, groin field, segmented, detatched breakwaters, and revetment as the most applicable alternatives. Specific alternatives were developed using various combinations of these elements to provide the shore protection and beach desired. Drainage ditches are assumed to remain in their present location. Alternatives developed for further study were sketched and are included as enclosures. These include:

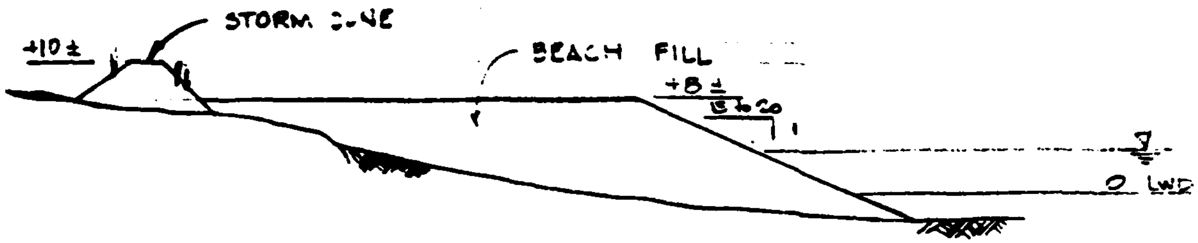
a) Alternative 1 - No-action.
b) Alternative 2 - Protective beach.
c) Alternative 3 - Protective beach retained with a groin field.
d) Alternative 4 - Protective beach and revetment.
e) Alternative 4A - Protective beach and revetment.
f) Alternative 5 - Protective beach retained with detatched breakwaters and revetment.
g) Alternative 6 - Protective beach retained with a groin and revetment.

It is suggested that preliminary design and cost estimates of these alternatives be performed and evaluated at the second iteration workshop. The protective beach and revetment alternative has two variations: Alternative 4 and 4A. Alternative 4A has a larger beach fill that could be developed by reorienting the shoreline to be normal to the net incident wave energy. Alternative 4 has the minimal beach length desired by ODNR.

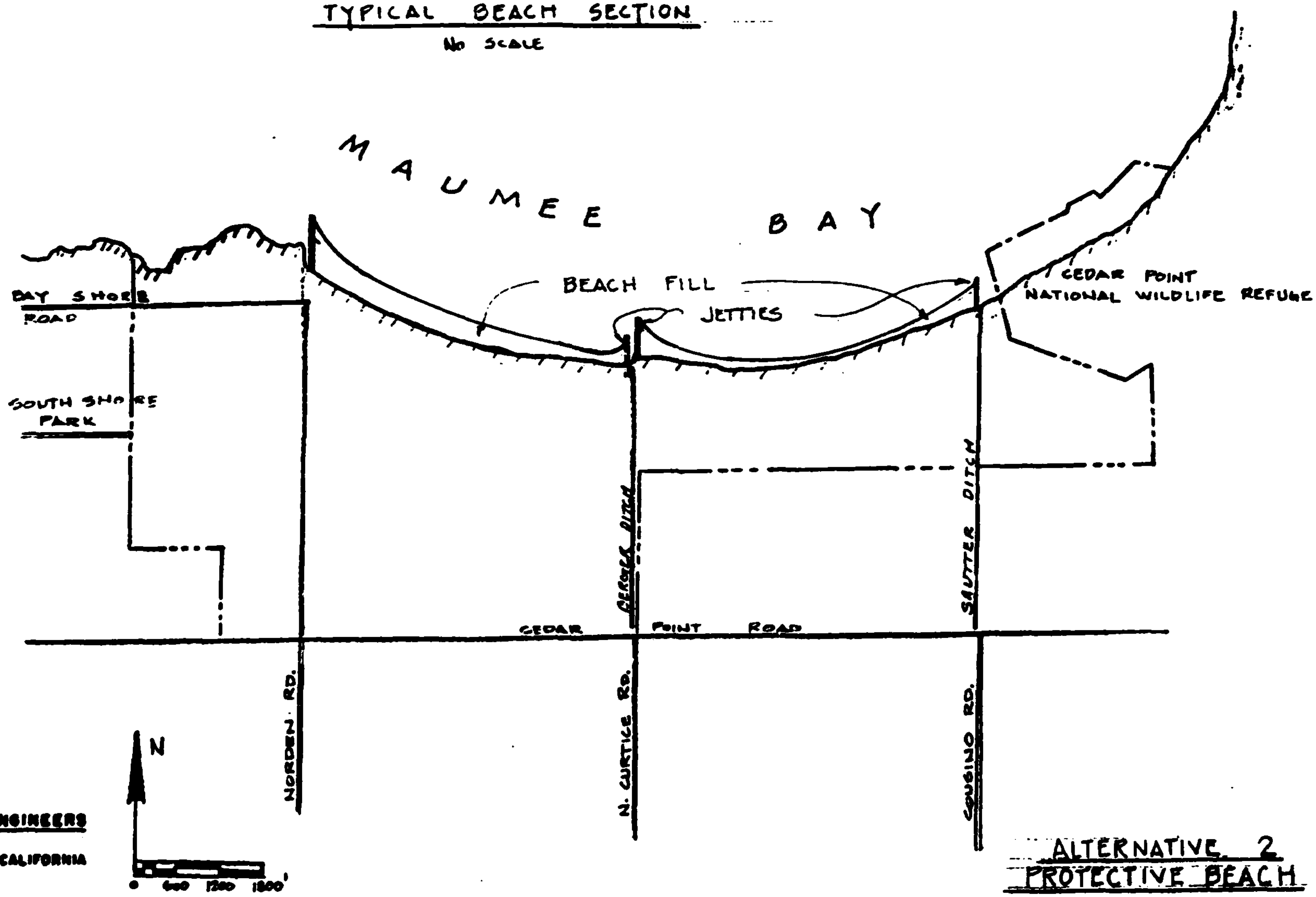


MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA

ALTERNATIVE 1
NO-ACTION

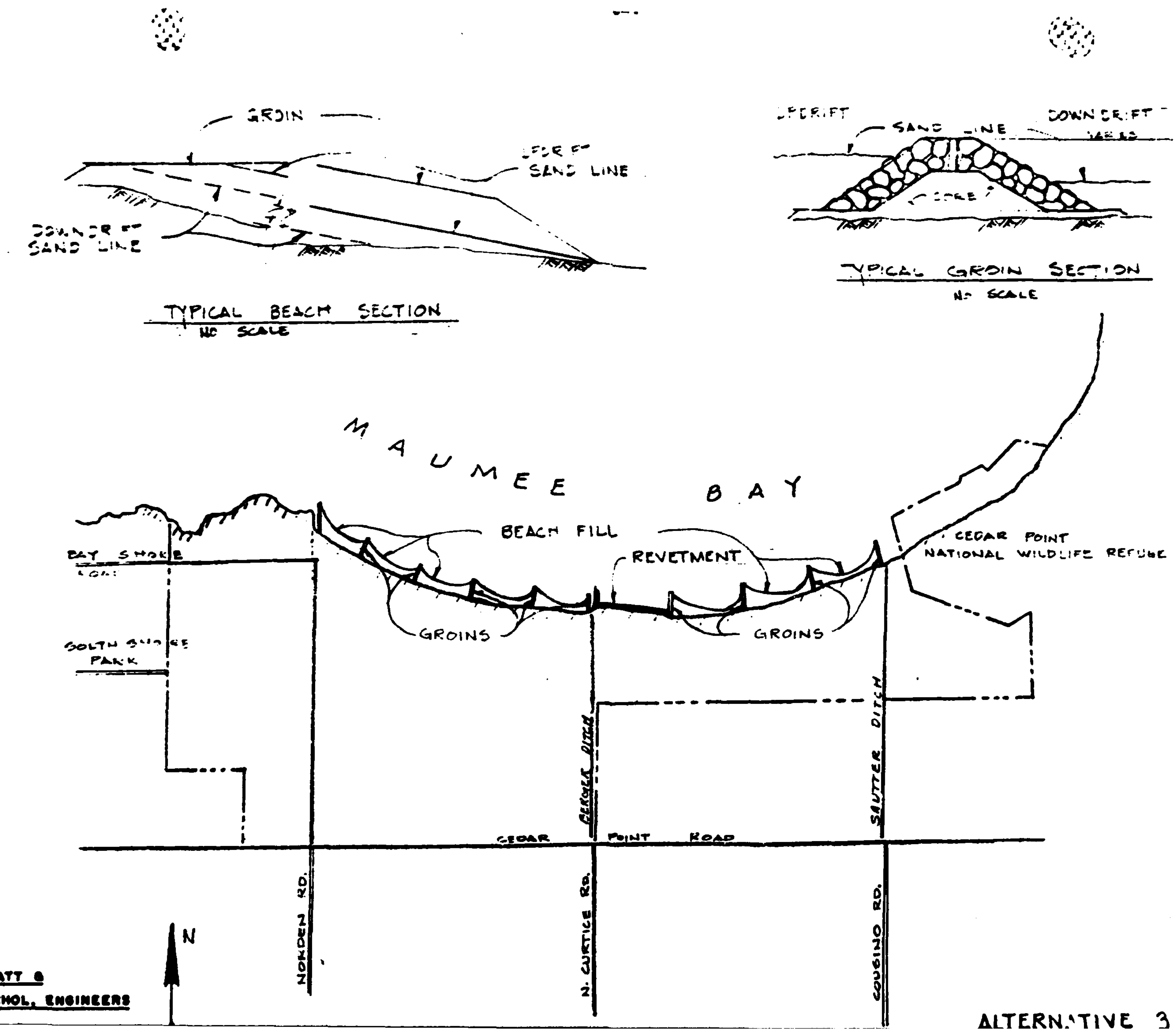


TYPICAL BEACH SECTION
No SCALE

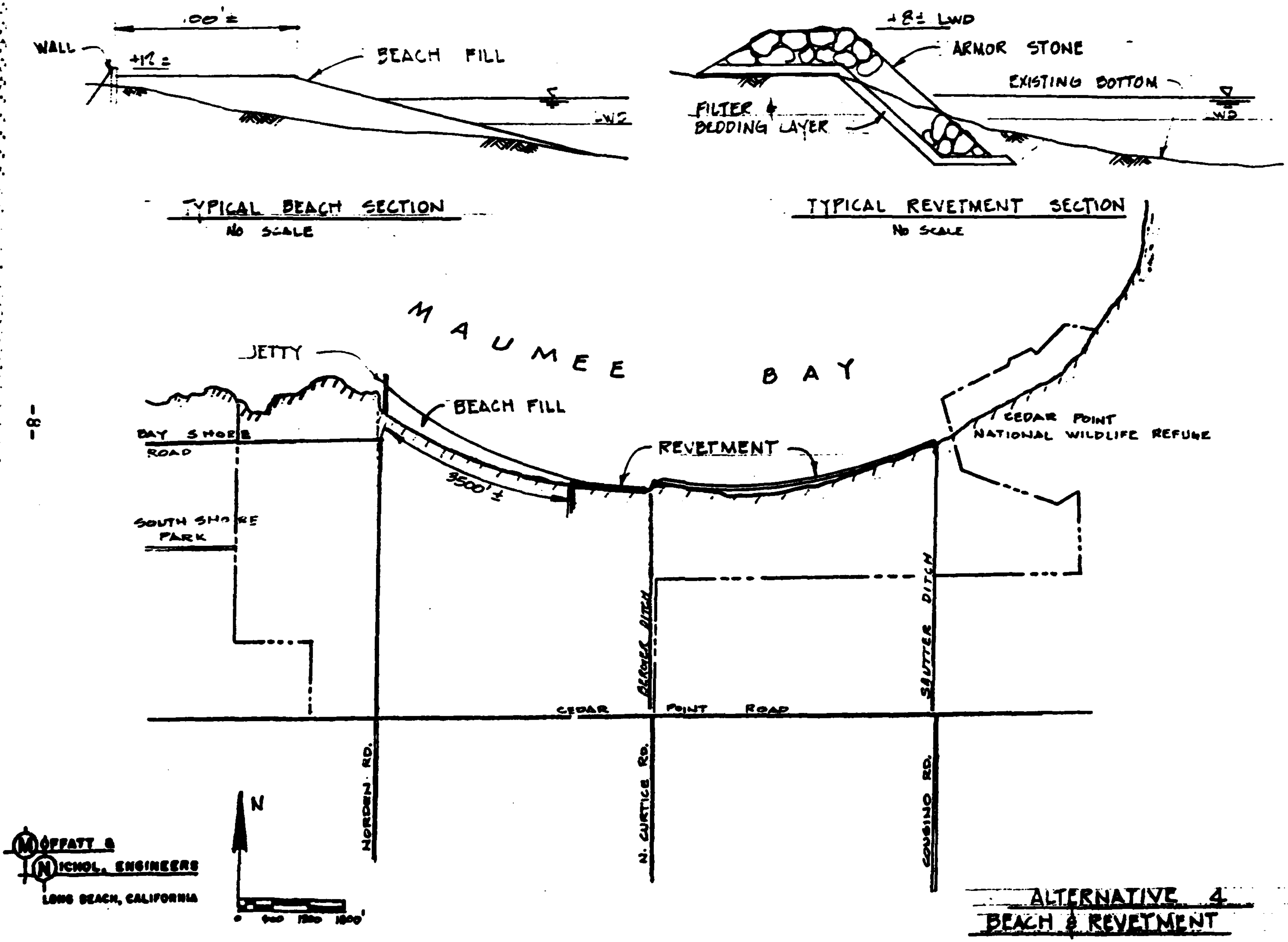


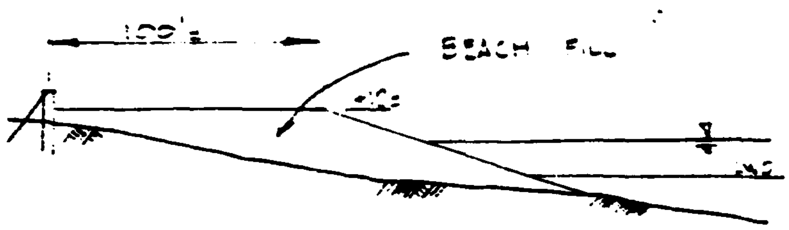
MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA

ALTERNATIVE 2
PROTECTIVE BEACH

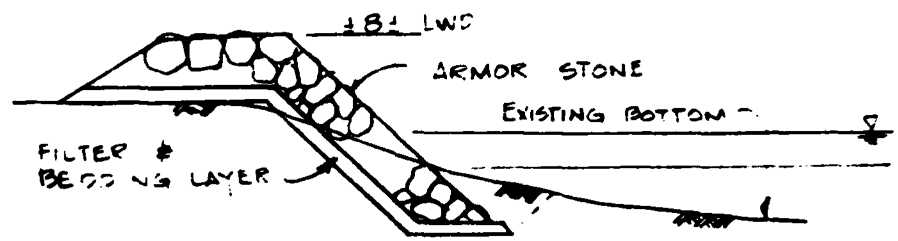


ALTERNATIVE 3

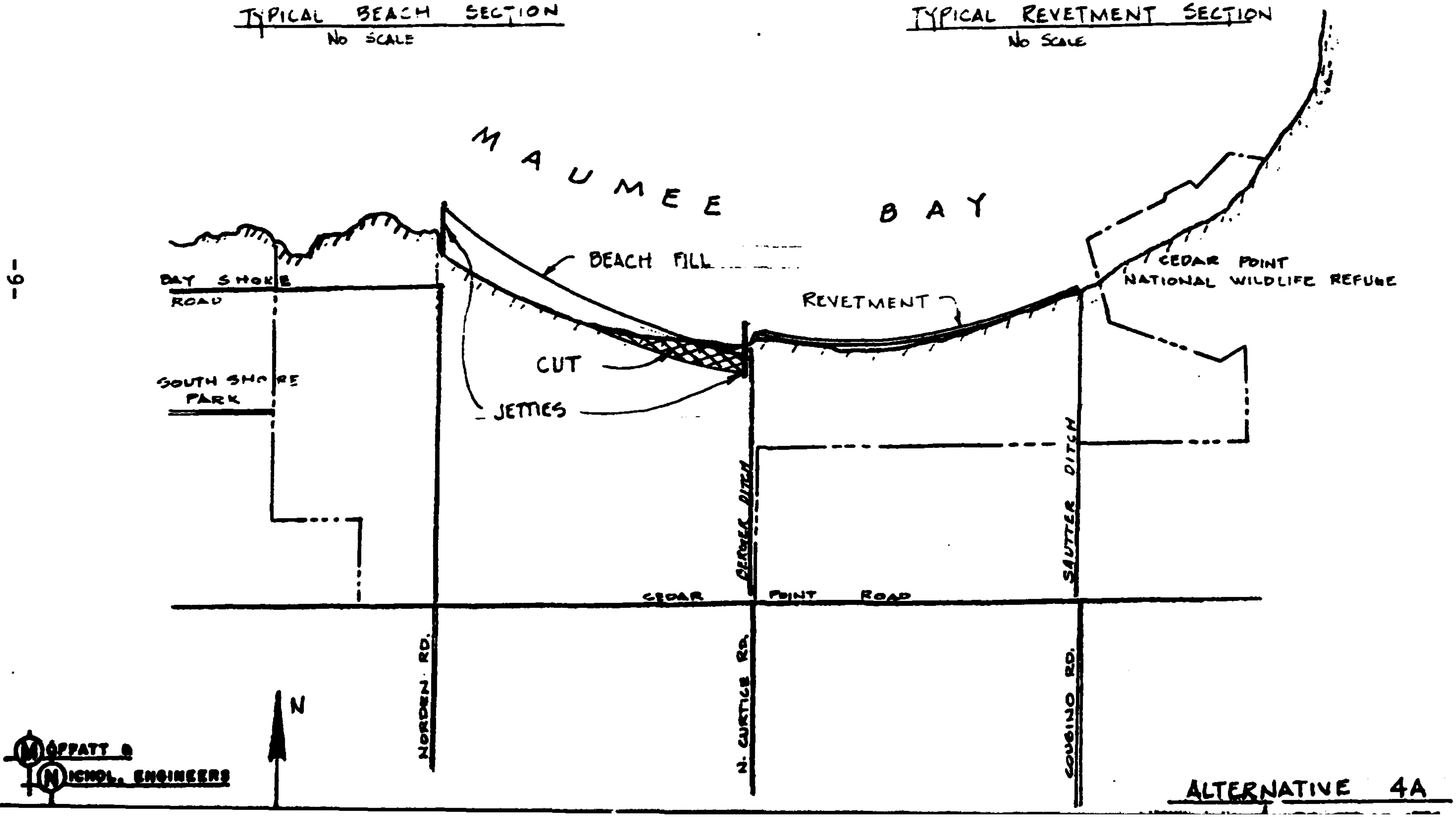

100'±
WALL
+12±
BEACH FILL
TYPICAL BEACH SECTION
NO SCALE
+8± LWD
ARMOR STONE
EXISTING BOTTOM
FILTER & BEDDING LAYER
TYPICAL REVETMENT SECTION
NO SCALE
MAUMEE BAY
JETTY
BEACH FILL
3500'±
REVETMENT
CEDAR POINT NATIONAL WILDLIFE REFUGE
BAY SHORE ROAD
SOUTH SHORE PARK
CEDAR POINT ROAD
NORDEN RD.
N. CURTICE RD.
COUSINO RD.
SAUTTER DITCH
N
MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA
ALTERNATIVE 4
BEACH & REVETMENT

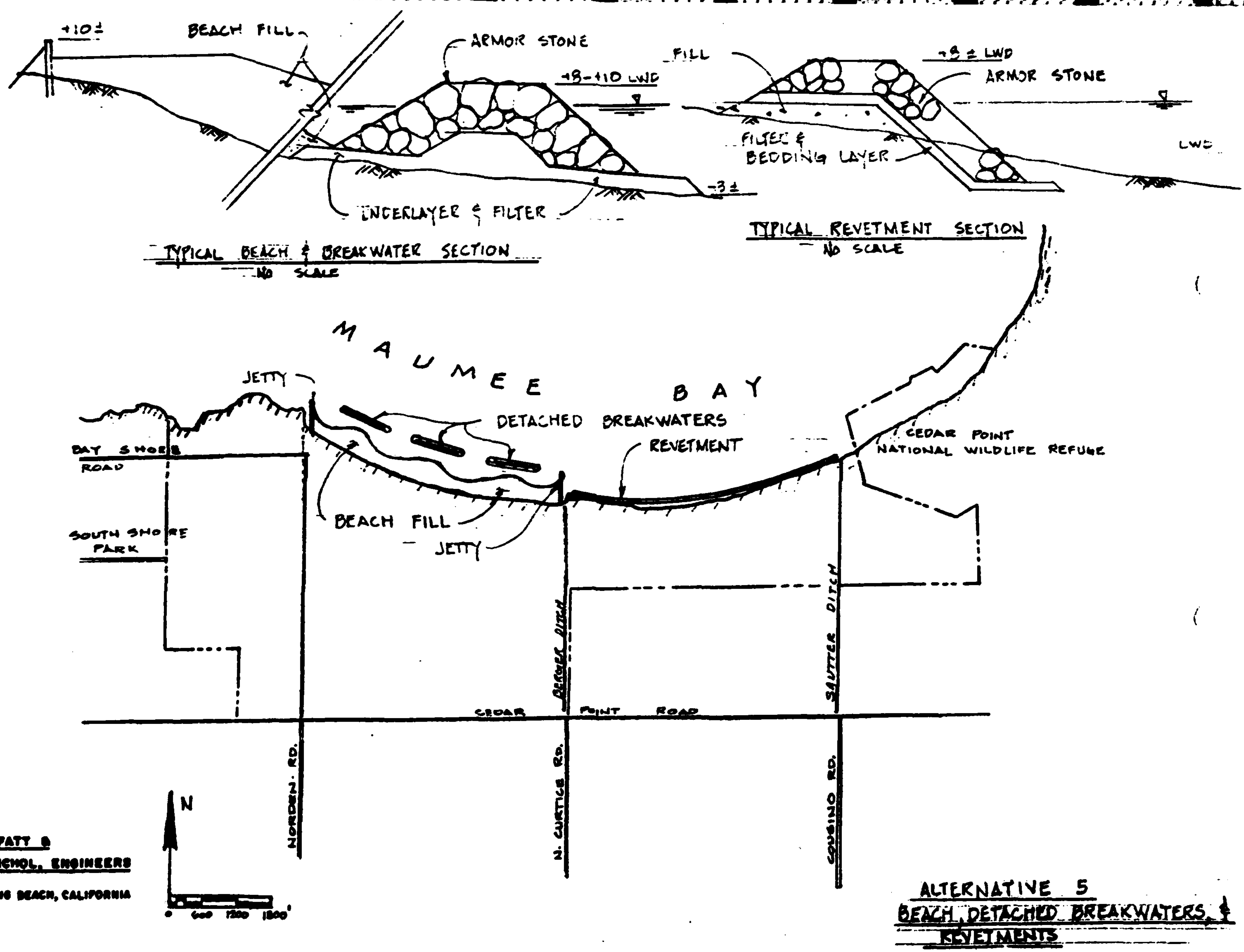


TYPICAL BEACH SECTION
No SCALE

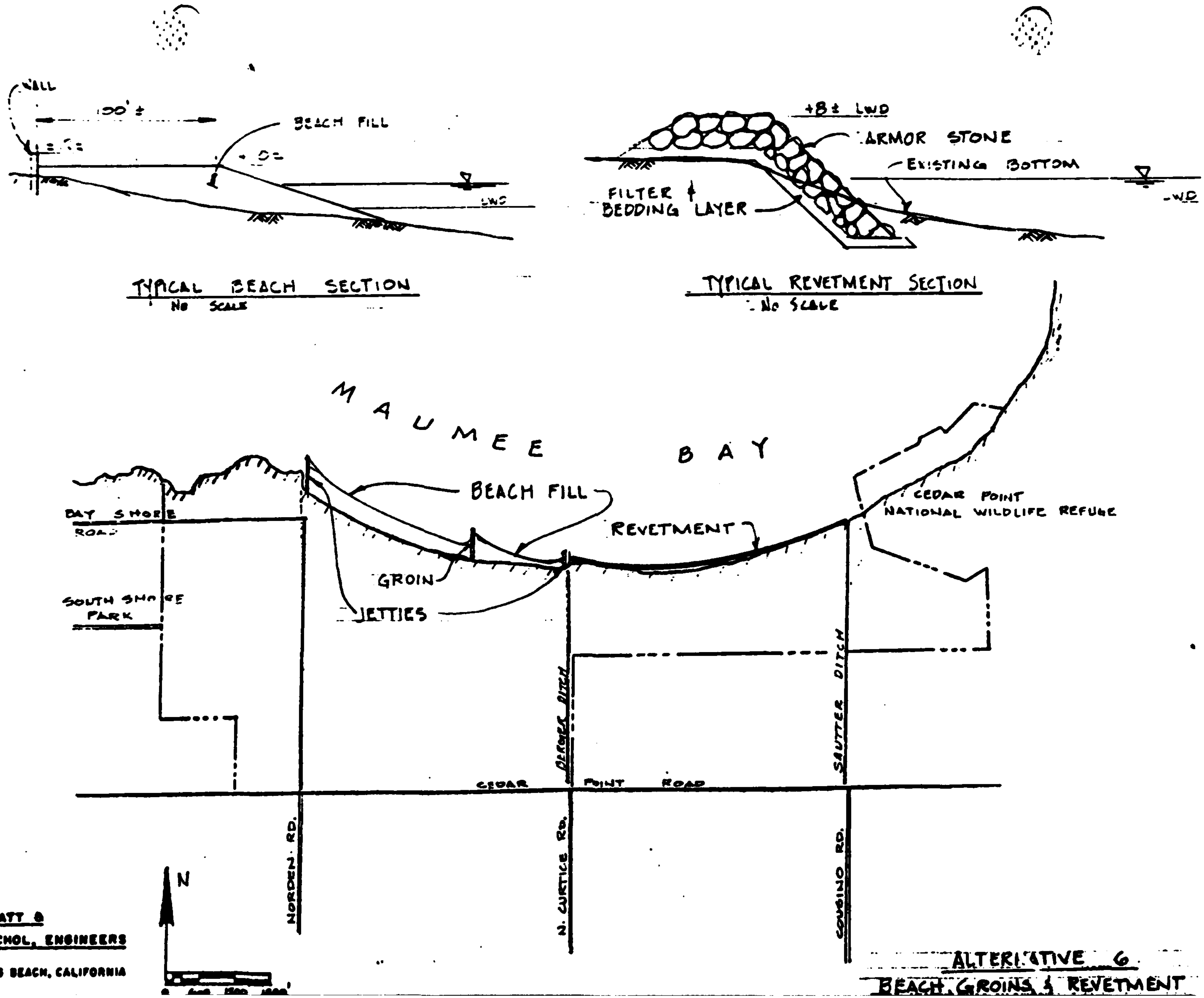


TYPICAL REVETMENT SECTION
No SCALE





+10±
BEACH FILL
ARMOR STONE
+8-+10 LWD
UNDERLAYER & FILTER
-3±
TYPICAL BEACH & BREAKWATER SECTION
NO SCALE
FILL
+8± LWD
ARMOR STONE
FILTER & BEDDING LAYER
LWD
TYPICAL REVETMENT SECTION
NO SCALE
MAUMEE BAY
JETTY
DETACHED BREAKWATERS
REVETMENT
BEACH FILL
JETTY
CEDAR POINT
NATIONAL WILDLIFE REFUGE
BAY SHORE ROAD
SOUTH SHORE PARK
BERGER DITCH
SAUTTER DITCH
CEDAR POINT ROAD
NORDEN RD.
N. CURTICE RD.
COUSINO RD.
N
0 600 1200 1800'
MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA
ALTERNATIVE 5
BEACH, DETACHED BREAKWATERS, & REVETMENTS


WALL
100' ±
BEACH FILL
TYPICAL BEACH SECTION
NO SCALE
LWD
+8± LWD
ARMOR STONE
EXISTING BOTTOM
FILTER & BEDDING LAYER
LWD
TYPICAL REVETMENT SECTION
NO SCALE
MAUMEE BAY
BEACH FILL
REVETMENT
GROIN
JETTIES
CEDAR POINT NATIONAL WILDLIFE REFUGE
BAY SHORE ROAD
SOUTH SHORE PARK
NORDEN RD.
N. CURTICE RD.
COUSINO RD.
SAUTTER DITCH
CEDAR POINT ROAD
N
MOFFATT & NICHOL, ENGINEERS
LONG BEACH, CALIFORNIA
ALTERNATIVE 6
BEACH, GROINS & REVETMENT

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

RECEIVED
JAN 29 1980
MOFFATT & NICHOL
ENGINEERS

NCBED-PW Re: Contract No. DACW49-79-C-0038 22 January 1980

REFER TO	
R.D.N.	✓
J.M.N.	
J.T.G.	
W.S.	
M.R.M.	
R.G.C.	✓
✓ Kim	

Mr. James R. Walker
Moffatt and Nichol Engineers
250 West Wardlow Road
Long Beach, CA 90807

Dear Mr. Walker:

We have reviewed the alternative plans for Maumee State Park and the energy flux calculations submitted by your office on 19 November 1979 and 5 December 1979, respectively. This letter summarizes our comments and views.

We agree that you have used the best method and data available for your calculations of energy flux, but we suggest that the results do not accurately represent what is actually occurring along the shoreline of Maumee State Park. We also suggest that Cedar Point has historically been a nodal point with little or no predominate longshore movement. This is shown in Figure 9 in "Report of Investigations No. 107" by the State of Ohio Department of Natural Resources to further illustrate the lack of longshore movement. A site inspection revealed drain tiles bared by erosion. These tiles were spaced approximately 50 feet apart and were situated perpendicular to the shoreline. If there were a strong easterly or westerly longshore current, these loose tiles would not have remained in place. We believe that the erosion occurring between Cedar Point and Norden Road is caused primarily by onshore-offshore movement. Consequently, any alternative that depends on a strong longshore current to be effective should not be used.

Comments on your suggested alternative plans are as follows:

<u>Alternative 1 - No Action</u> - This is not a viable alternative, but must be addressed in all Corps projects. However, if no Corps project can be justified, the Corps cannot participate in any improvements to the park.

<u>Alternative 2 - Protective Beach</u> - This concept may have possibilities, although there is some doubt that, unless the sand is very coarse, which is not recommended for a swimming beach, erosion will persist requiring excessive maintenance. For the wildlife area, a revetment is preferred as being the least cost and most effective method of providing erosion protection. However, the U. S. Fish and Wildlife Service may have some objections to this type of structure in that it may prevent fish spawning. Therefore, along with a revetment, it is suggested that a detached breakwater also be considered.

If this plan proves to be the least cost alternative, more detailed analyses must be conducted on the sand requirements for the protective beach.

Alernative 3 - Beach and Groin Field - If your analysis on littoral drift is correct, this plan is a definite possibility, except, as in Alternative 2, consider a revetment along the wildlife area with the detached breakwaters as a backup.

Alternative 4 and 4A - Beach and Revetment - These plans are now similar to Alternative 2. Therefore, these alternatives (4 and 4A) can be eliminated and different methods of beachfill along the swimming beach can be considered in Alternative 2.

Alternative 5 - Beach, Detached Breakwaters, and Revetments - This alternative has the most favorable characteristics. The revetment along the wildlife area is preferred. The beachfill along the swimming beach with jetties at each end and the detached breakwaters would appear to be adequate protection against littoral drift or direct onshore-offshore wave action. However, a reorientation of the breakwaters could possibly eliminate the use of end jetties. This plan should be considered further.

Alternative 6 - Beach, Groins, and Revetment - Again, this plan is similar to alternatives 2, 4, and 4A. The most feasible protection should be considered for the swimming beach and presented in Alternative 2.

In summary, the alternatives to be considered further are:

a. Alternative 1 - No Action.

b. Alternative 2 - Protective Beach, but provide a revetment along the wildlife area with a detached breakwater as an alternative.

c. Alternative 3 - Beach and Groin Field, but provide a revetment along the wildlife area. Again, consider detached breakwaters along the wildlife area.

d. Alternative 4 - Beach, Detached Breakwaters and Revetment.

Based on the above viable alternative plans, proceed with your benefit and cost evaluations.

Also, enclosed for your information, is a letter from ODNR concurring with our method of computing benefits and with our choice of alternatives. The

NCBED-PW
Mr. James R. Walker

two alternatives J. Swartzmiller is referring to are Alternatives 2 and 4 above.

Sincerely,

THOMAS R. BRAUN
Lt Col, Corps of Engineers
Contracting Officer

1 Incl
as stated

NCBED-PW 12 June 1981

James Swartzmiller, Chief Engineer
Ohio Department of Natural Resources
Fountain Square
Columbus, OH 43224

Dear Mr. Swartzmiller:

The recently completed Preliminary Feasibility Report for Maumee Bay State Park has been approved by our North Central Division. This approval, however, was contingent upon performance of certain tasks during the current Stage 3 study. These tasks will require certain input from the Ohio Department of Natural Resources, which we are requesting at this time.

In order to determine which alternative plan of improvement will maximize net benefits, it will be necessary to design and cost a revetment for protection of the entire park shoreline, and to compare that analysis with a reanalysis of the No-Action Plan and the Strutural Alternative (Plan 3 in the Preliminary Feasibility Report), consisting of a Protective Sand Beach, Offshore Breakwaters, and Revetment for which you provided preliminary park recreational development information late in Stage 2. Therefore, we will need your Park Recreational Development Plan, along with associated construction and maintenance costs, for these three options:

1. Revetment Along Entire Shoreline

2. No-Action

3. Plan 3 - Protective Beach, Offshore Breakwaters, and Revetment

We would appreciate receipt of the requested data so that we can properly evaluate the various options during Stage 3. Without your input, it will be necessary for us to estimate these costs and levels of development. Our estimates will not have the expertise available from your staff, probably will not be as accurate as your input would be, and may not be to your best

NCBED-PW
James Swartzmiller, Chief Engineer

advantage. If there are any questions, please contact Richard Mammoser, Study Manager, at (716) 876-5454, extension 2294.

Sincerely,

DONALD M. LIDDELL
Chief, Engineering Division

CF:
✓NCBED-PW
NCBCO-CL

Mammoser________
Zorich________
Gilbert________
Hallock/________
Liddell________

ODNR
Ohio Department of Natural Resources
OFFICE OF CHIEF ENGINEER
Fountain Square · Columbus, Ohio 43224 · (614) 466-4633

July 9, 1981

Donald M. Liddell, Chief, Engineering Division
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

In reply to your request of June 12, 1981 for additional information on projected development at Maumee Bay State Park, we submit the following:

1) Revetment along entire shoreline - Total development cost -	$ 22,000,000
2) No action Total development cost -	5,200,000
3) Plan 3 - Protection Beach & Revetment Total development cost -	27,000,000

This office has no records on maintenance costs strictly for facilities on an annual basis.

In addition to the above costs we have prepared the following projected attendance figures for your consideration:

Activity	Full development w/protection (Corps study)	Revetment along entire shoreline w/o beach (ODNR Study)	No Action (Corps Study)
1. Swimming & Sunbathing	640,500	6,000	6,000
2. Picnicking	836,000	334,888	167,000
3. Hiking	18,000	18,000	8,000
4. Fishing	2,500	2,000	2,000
5. Camping	89,000	71,000	71,000
6. Golfing	41,000	39,000	39,000
Total:	1,627,000	470,888	293,000

It should be noted that none of the above alternatives show the loss of lodge attendance if the shore protection is not provided. Without protection, the lodge would not be constructed. Estimate lodge attendance is 75,000 annually.

Should you desire additional information please advise.

Sincerely,

JAMES A. SWARTZMILLER
CHIEF ENGINEER

JAS:bm
cc: Roger Hubbell
Donald Olson
Robert Lucas

ODNR

Ohio Department of Natural Resources

Fountain Square • Columbus, Ohio 43224 • (614) [redacted] 265-6886

July 1, 1982

Colonel George P. Johnson
District Engineer
U.S. Army Engineer District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

Reference is made to our letter of intent of 6 January 1982 to serve as the non-federal sponsor and cooperate in the development of the proposed shore protection measures for Maumee Bay State Park.

Based on the results of telephone conversations between Messrs. Mammoser and Gilbert of your staff and Messrs. Swartzmiller and Lucas of my staff concerning policy changes at OCE and modified items of local cooperation, we wish to revise our earlier correspondence.

It is the intent of the Ohio Department of Natural Resources, subject to appropriations of all necessary funds by the Ohio General Assembly, to provide the following items of local cooperation with respect to development of the Maumee Bay State Park Shore Erosion Protection and Beach Restoration project:

a. Provide without cost to the United States, all lands, easements, and rights-of-way, including borrow and spoil disposal areas as determined by the Chief of Engineers, necessary for the construction and subsequent maintenance of the project;

b. Contribute in cash 30 percent of the project construction cost, such contribution presently estimated at $3,290,000 to be paid in a lump sum prior to initiation of construction. In the event that construction is scheduled to take more than 1 year, said contribution may be made in annual installments over the period of construction at a rate proportionate to the proposed or scheduled apportionment of Federal funds. In either event, the final apportionment of cost will be made after actual costs have been determined;

c. Provide appurtenant facilities shown on the State Master Plan, for which recreational benefits have been taken, as funds are made available;

d. Hold and save the United States free from all claims for damage due to construction, operation, and maintenance of project, except for damage due to the fault or negligence of the Government or its Contractors;

e. Provide without cost to the United States all alterations and relocations to existing improvements including highways, buildings, utilities, sewers, and other facilities which may be required because of the project;

f. Construct permanent park structures and park roads above the 100-year water surface elevation of 577.3 IGLD and consider such elevation when constructing other facilities, which would be significantly affected by high waters;

g. Maintain and repair the protective and improvement measures during the useful life thereof as may be required to serve their intended purposes, subject, however, to Public Law 826, 84th Congress, 2nd Session, which provides that periodic beach nourishment may be classified as an item of "Construction," and as such may be shared by the Federal Government, this cost-sharing being 30 percent non-Federal and 70 percent Federal for a trial period of 5 years, whereupon a reevaluation and renegotiation of those sections of the Local Cooperation Agreement applicable to the periodic beach nourishment program will be made;

h. Control water pollution from within the park to the extent necessary to safeguard the health of the bathers;

i. Maintain continued ownership and use of the shore upon which the Federal participation is based during the economic life of the project;

j. Provide and maintain necessary access roads, parking areas, and other public use facilities open and available to all on equal terms;

k. Comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisitions Policies Act of 1970, Public Law 91-646, approved 2 January 1971, in acquiring lands, easements, and rights-of-way for construction and subsequent maintenance of the project, and inform affected persons of pertinent benefits, policies, and procedures in connection with said Act; and,

l. "Comply with Section 601 of Title VI of the Civil Rights Act of 1964 (P.L. 88-352) and Department of Defense Directive 5500.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, in connection with the construction and operation of the project."

It is our hope that with the delineation of each item of local cooperation, as expressed herein, the Corps of Engineers will make every effort to expedite the Feasibility Report - Maumee Bay State Park Shoreline Erosion Beach Restoration through the necessary review process.

We look forward to cooperating with you on this important project.

Sincerely,

Robert W. Teater

ROBERT W. TEATER
Director

RWT:pj

OFC. MGMT. OAS

17 Nov 83 10 04

ODNR
OHIO DEPARTMENT OF
NATURAL RESOURCES

Fountain Square
Columbus, Ohio 43224

November 14, 1983

Robert R. Hardiman, Colonel
District Engineer
U.S. Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Hardiman:

On November 14, 1983, members of our staff met with the A/E firm the Ohio Department of Natural Resources engaged to produce conceptual plans for the proposed lodge and cabins development at Maumee Bay State Park. Based on the results of this meeting, the lodge facility will be located near the center of the park lands, along the northerly terminus of North Curtis Road, and immediately adjacent to the Lake Erie shoreline. The cabins will be constructed immediately east of this location.

The final location of these proposed facilities underscores the overriding requirement that the entire park shoreline receive adequate protection from erosion.

In my previous correspondence to you of November 2, 1983, I expressed a preference for erosion protection alternative 3b, and further indicated that any alternative not affording the same degree of protection as alternative 3b would be unacceptable. I now want to emphatically express that the Ohio Department of Natural Resources will not and cannot develop the lodge, cabins, and ancillary facilities without total shoreline protection. Accordingly, our participation in any federally authorized project is contingent upon this factor.

Again, I wish to thank you and your staff for your continued cooperation. We are looking forward to an expedient review of the results on the Maumee Bay State Park Shoreline Erosion/Beach Restoration Study.

Sincerely,

Myrl H. Shoemaker

MYRL H. SHOEMAKER
Director

MHS:mh

ODNR
OHIO DEPARTMENT OF
NATURAL RESOURCES

Fountain Square
Columbus, Ohio 43224

November 2, 1983

11-10-83

Robert R. Hardiman, Colonel
District Engineer
U.S. Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

RE: October 31, 1983 Field Review on Maumee Bay State Park
Proposed Shore Erosion Control Project

Dear Colonel Hardiman:

Based on the results of the referenced meeting, I am writing to summarize the position of the Ohio Department of Natural Resources concerning proposed erosion protection measures for the Lake Erie shoreline of Maumee Bay State Park.

Early in the planning process it was agreed that as a major premise, protection along the entire 10,000' of park shoreline must be an integral feature of the park if it is to be developed as a multi-recreational complex. Further, the economic evaluation on total cost for protecting the entire shoreline and total water-related and water-enhanced benefits derived would be based on the entire park complex. Such agreement is documented in the District Engineer's report on the Maumee Bay State Park project of September, 1982 (revised June, 1983).

As you are aware, the Congress is currently considering water resources legislation that includes a provision authorizing the Maumee Bay State Park shore protection project as proposed in the District Engineer's report. Any attempt to modify the agreed upon premise for economic evaluation of the proposed project could seriously jeopardize the selected alternative 3b, and negate expected Congressional action. Any amended project recommendation as may be considered by the staff of BERH that would not provide the degree of protection, nor include appropriate beach facilities afforded by alternative 3b, would not be acceptable to the Ohio Department of Natural Resources.

Maumee Bay State Park-Proposed Shore
Erosion Control Project

We would appreciate your cooperation in conveying our position on this project to appropriate officials in the Corps. Further, we sincerely appreciate the tremendous time and effort expended by your staff toward advancing the proposed project to the Board.

We look forward to a positive decision by the BERH in sustaining the recommendations of both the District and Division Engineers.

Sincerely,

Myrl H Shoemaker

MYRL H. SHOEMAKER
Director

MHS:mh

OFC. MGMT. OAS

3 Nov 83 11 04

ODNR

OHIO DEPARTMENT OF NATURAL RESOURCES

Fountain Square
Columbus, Ohio 43224

November 1, 1983

U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Attention: John Zorich

Dear Sir:

Per your request attached is a copy of the February 11, 1982 letter from the Ohio Department of Health regarding a proposed swimming beach at Maumee Bay State Park.

Sincerely,

JAMES A. SWARTZMILLER
CHIEF ENGINEER

JAS:bm
Encls.
cc: R.L. Lucas

246 N. High Street
Post Office Box 118
Columbus, Ohio 43216

Telephone (614) 466-3543

DEPARTMENT OF HEALTH
STATE OF OHIO

JAMES A. RHODES
Governor

JOHN H. ACKERMAN, M.D., M.P.H.
Director of Health

February 11, 1982

Earnest Oaks
Office of Chief Engineer
Department of Natural Resources
Fountain Square
Columbus, Ohio 43224

Dear Ernie,

I found some more recent data on Maumee Bay and I ran some copies for you.

Looking at the data, almost all of the high counts recorded are associated with rainfall. We do not consider such counts as reflective of ambient water quality.

Based upon the data, I do not see any unusual pollution influences in the area. I would not hesitate to approve this area for beach development.

Sincerely,

Timothy Horgan
Sanitarian in Charge
Recreation Sanitation Unit
Ohio Department of Health

TH/by

Enclosures

SPECIAL WATER BACTERIOLOGY IN OHIO BATHING AREAS

Maumee Bay St. Pk. — Beach; Lucas Co. — Health District; E & W Ends — Sampling Point; NWBL — Laboratory; Jim Brewer — Manager; 1981 — Year

Undeveloped/proposed beach

	Date Collected	BACTERIA COUNTS: Fecal Coliforms/ 100 ml	average	Geometric Mean	Fecal Strep/ 100 ml	Log	Geometric Mean	Total Coliform/ 100 ml	Geometric Mean	Percent of Samples 400/100ml	Number Swimmers	Number Sunbathers	Sunny	Hazy	WEATHER: Cloud.	Rain	WIND: Direction	Velocity mph	Water Cloudy	Evidence of Algae	Water Clear	Wave Height	Wave Direction	Water Temperature	Abnormal Water Condition	Unusual Weather Condition Prev. Da	Pollution Sources Active - Yes	Pollution Sources Active - No	Specimen Collected By	Time Collected
E/W	6/8	10									0	0			X		SW	6	X			calm		65				X	SD	9:15 AM
	6/16	390 450	420								0	0	X				SW	9	X			calm		65		Rain [illegible]		X	SD	8:50
	6/22	180 420	300	108							0	0			X	X	W-NW	15	X			1-3'	NW	71		R		X	SD	10:15
	6/24	600 440	520	160							0	0		X			SW	9	X			calm		71	very muddy			X	SD	10:15
	7/6	400 210	305	182							0	0	X				NE	8	X			1-3	NE	70	muddy			X	SD	9:00
(1)	7/20	<10 33	17	202							0	0			X		SW	5	X			calm		73				X	SD	9:00
	7/27	1600 1200	1400	258							0	0			X		NE	8	X	X		1-3	N-NE	73		R		X	SD	11:00
	8/3	50 33	41	173							-	0			X	X	calm		X	X		calm		74		light rain		X	SD	9:00
	8/10	34 34	34	100							-	0	X				SW	8	X	X		calm		74				X	SD	10:00
(1)	8/24	<10 <10	<10	32							-	0	X				NW	7	X	X		1-2'	NW	73				X	SD	9:05
	8/31	350 130	240	24							-	0				X	S-SW	5	X	X		calm		72		R		X	SD	9:15

ODH
6/77

SPECIAL WATER BACTERIOLOGY IN OHIO BATHING AREAS

Maumee Bay St. Pk. — Beach | Lucas Co. — Health District | Proposed Beach, E+W — Sampling Point | NWRL — Laboratory | Jim Brewer — Manager | 1980 — Year

East / west

BACTERIA COUNTS												WEATHER				WIND													
Date Collected	Fecal Coliforms/ 100 ml	~~Log~~ average	Geometric Mean	Fecal Strep/ 100 ml	Log	Geometric Mean	Total Coliform/ 100 ml	Geometric Mean	Percent of Samples 400/100ml	Number Swimmers	Number Sunbathers	Sunny	Hazy	Cloudy	Rain	Direction	Velocity	Water Cloudy	Evidence of Algae	Water Clear	Wave Height	Wave Direction	Water Temperature	Abnormal Water Condition	Unusual Weather Condition Prev. Day	Pollution Sources Active - Yes	Pollution Sources Active - No	Specimen Collected By	Time Collected
5/19	L.A. 75	75								0	0			X		N	15	X			1"	N	54		Rain		X	J.C.	10:10 AM
6/2	100 L.A.	100	87							0	0			X		SW	15	X			2"	SW	65		Storm		X	SD	9:30
6/16	210 370	290	130							0	0	X				N-NE	15	X			5"	N-NE	64		Storm		X	SD	9:30
6/30	56 190	123								0	0			X		N-NW	10	X			4"	N-NW	67				X	SD	10:30
7/14	9 15	12	80							0	0	X				S-SW	10	X			Calm		73				X	SD	9:20
7/28	5 13	9	52							0	0				X	E-SE	3	X			1'	E-SE	77		Rain		X	SD	9:10
8/11	140 42	91	51							0	0			X		N-NE	3	X			2'	N-NE	76				X	SD	9:30
8/25	72 42	57	37							0	0	X				W-SW	5	X	X		6"	W-SW	70				X	SD	9:00

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Columbus Field Office
3990 East Broad Street
Columbus, Ohio 43215

IN REPLY REFER TO:

December 15, 1983

Colonel Robert R. Hardiman
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Attention: Bill Butler

Dear Colonel Hardiman:

This responds to the recent requests by Mr. William Butler of your staff for the position of the U. S. Fish and Wildlife Service on two proposed revisions by the Board of Engineers for Rivers and Harbors on the Maumee Bay State Park Shoreline Erosion Study in Lucas County, Ohio.

The first proposed revision is the addition of eight offshore breakwaters on the western half of the project area. Each breakwater would be 300 feet long and would be located 600 feet offshore in six feet of water. The addition of these structures would benefit aquatic resources by providing a rock substrate which would be used by many species of fish for spawning, nursery, cover, and feeding purposes. Sport fishing would benefit also due to the structures supporting fish populations and concentrating these fish populations in an area where the lake bottom is composed of sand and silt. The U. S. Fish and Wildlife Service does not have concerns regarding the addition of these offshore breakwaters.

The second proposed revision is the deletion of the rubblemound revetment along the eastern half of the project area. Included in this area is a 244-acre wetland composed of persistent emergents and broad-leaved deciduous forest species. This wetland is a remnant of the Great Black Swamp which originally extended 120 miles across northwestern Ohio. The following material is from our August 31, 1983 Final Fish and Wildlife Coordination Act Report on this project.

> The entire southwestern Lake Erie area is well known for its diverse avifauna. The park is no exception and is in an area which experiences particularly high concentrations of birds in the spring and fall. This appears to be due to the fact that the park lies within the pathway of four migration routes. Two of the four routes are major continental routes - the Atlantic and Mississippi Flyways. Each passes over the western end of Lake Erie. The other routes are local routes. One route follows the Maumee River and then the Lake Erie shoreline. The other route follows the shoreline but crosses Maumee Bay at the Cedar Point spit.

The Ottawa National Wildlife Refuge staff has compiled a list of 267 birds identified within the refuge complex (Table 52 of USDI, FWS 1979). This list is representative of birds which may be found in the southwestern Lake Erie area including the park. Thirty-three species are year-round residents. Eighty-five species breed but do not winter in the area. The remaining one hundred and forty-nine species occur as migrants.

One major reason for the high number of bird species in this area is the existence of this remnant wetland from the Great Black Swamp. The rubblemound revetment will insure the continued existence of this valuable and irreplaceable wildlife area. The rubblemound revetment will also preserve the area as an integral part of the proposed Maumee Bay State park development. The U. S. Fish and Wildlife Service is opposed to deleting the rubblemound revetment from the project for the above reasons.

Sincerely yours,

Kent E. Kroonemeyer

Kent E. Kroonemeyer
Supervisor

cc: Chief, Ohio Division of Wildlife, Columbus, OH
ODNR, Outdoor Recreation Service, Attn: M. Colvin, Columbus, OH
Ohio EPA, Attn: A. Lynch, Columbus, OH
U.S.EPA, Office of Environmental Review, Chicago, IL

APPENDIX F
PUBLIC INVOLVEMENT

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

MAUMEE BAY STATE PARK

FINAL FEASIBILITY REPORT (STAGE 3)

PUBLIC INVOLVEMENT

APPENDIX F

TABLE OF CONTENTS

EXHIBITS

SUMMARY MINUTES
FOR
ORIENTATION WORKSHOP
ON
WESTERN LAKE ERIE SHORE FEASIBILITY STUDY, OHIO
WEDNESDAY, 10 JANUARY 1979

1. An Orientation Workshop concerning the Western Lake Erie Shore, Ohio, Study, was held at 1 p.m. on 10 January 1979, at the Jerusalem Township Hall on Route 2, Curtice, Ohio. The purpose of this Workshop was to inform public officials and other principal interests in Lucas County of the Study and to solicit their views on water resources problems and needs in the study area. This input on problems and needs is instrumental in scoping the future study effort and will be incorporated into the Reconnaissance Report currently underway.

The study deals with the feasibility of providing for beach erosion control, flood protection, and related purposes in the study area.

2. John Zorich, Chief of the Western Basin, welcomed all present and opened the meeting with self-introduction. Discussion of the Western Lake Erie Shore Study was initiated with a review of the Committee Resolution requested by Honorable Delbert Latta on 11 April 1974. The proposed Corps of Engineers program and study schedule, including progress to date, was then presented and the Corps of Engineers study process was explained in more detail as outlined in an information package that was given to Workshop participants. A list of Workshop Attendees is provided at the end of these minutes.

3. Subsequently, Mr. Zorich discussed previous Corps of Engineers studies and completed projects located within the study area. Information was also provided as to current Corps of Engineers activities, namely current studies and authorized projects. Maps of the shoreline area between Ohio-Michigan line and Marblehead, Ohio, depicting this information was also provided Workshop participants as part of the information packet.

4. A brief slide presentation of the shoreline was made by the Project Manager, James H. DeLaPlante III. The purpose of the slide presentation was to acclimate the audience and the Corps Interdisciplinary Team for this study to the geographical and topographical characteristics of the shoreline within the study area especially the Lucas County shoreline and problem areas.

5. Mr. Charles Carter, Head of Lake Erie Section of the Division of Geological Survey of Ohio Department of Natural Resources (ODNR)

lad !

EXHIBIT 1

explained that a Lake Erie Shore Erosion and Flooding Report for Lucas County has been just completed, and is available. A similar report is presently being prepared by the Lake Erie Section compiled for Ottawa County, and will be available late in 1979.

6. Mr. Fred Ball of the Office of the Chief of Engineering, ODNR, presented an overview as to the State of Ohio's intentions for developing Maumee Bay State Park. Camp grounds development and construction is expected to begin this year. The State's position at present is to incorporate its recreational development plan in with potential flood control and erosion protection facilities and a recreational beach that the Corps of Engineers will investigate as part of the Western Lake Erie Shore study. Two major concerns about the Maumee State Park project were expressed by local officials during this discussion. First, Mr. Horvath of the city of Oregon is concerned that the proposed Maumee Bay Park project could adversely affect the existing drainage system and the area to be developed. Secondly, Mr. Wilson, Lucas County Engineer, is concerned that heavy construction vehicle traffic on existing area roadways could likely damage the roadways and require repairs and possibly replacement.

7. Mr. Thomas Schultz of the Toledo Metropolitan Area Council of Governments explained their involvement with the Toledo area and the data that is available to the Corps of Engineers.

8. Mr. Roger Van Hoose, president of Lake Erie Conservancy District Number One, explained the history of the conservancy district and clarified some points as to the Corps of Engineers involvement with both the Howard Farms Reno Beach Conservancy and Lake Erie Conservancy Number One regarding projects constructed in past years.

9. Some areas of potential problems were discussed with respect to erosion and flood inundation from high Lake Erie levels and wave runup. Some areas that were identified are:

a. Flooding problems in the village of Bono.

b. Severe flooding in Lucas County occurs from Little Cedar Point to Harbor View in the city of Oregon.

c. Potential flooding area along Crane Creek affecting upstream areas.

d. Flooding problems to inland agricultural lands due to high lake levels.

e. Boat wash erosion to dikes at marinas in the Cooley Creek and Wards Canal areas.

f. Possible water quality problems due to additional dike disposal construction as proposed in Toledo Harbor by the Port Authority.

The participants were also asked to contact James H. DeLaPlante III of the Buffalo District by mail or by phone if they thought of other water resources problem areas (shoreline erosion of public lands, flood inundations caused or aggravated by high Lake Erie levels, etc.) after the meeting.

10. Mr. Zorich stated that the Buffalo District is planning to conduct a Public Meeting on the Western Shore study in the spring of 1979. Hopefully, the information provided by interested officials and the general public at the Workshop and upcoming Public Meeting will enable the Corps to establish a study effort along this 50-70 mile reach of Lake Erie consistent with the problem and needs of the affected area and the authorizing resolution for the study.

11. Closing remarks were made by Mr. John Zorich, thanking all present for their participation in the Workshop, and informing participants that copies of the summary minutes of the meeting would be sent to them for information, review, and comments.

12. The meeting was adjourned at 4:30 p.m.

JAMES H. DeLaPLANTE III
Project Manager

ORIENTATION WORKSHOP
FOR
WESTERN LAKE ERIE SHORE FEASIBILITY STUDY, OHIO
WEDNESDAY, 10 JANUARY 1979

ATTENDANCE

Name	Representing
John Zorich, Chief, Western Basin	U.S. Army Corps of Engineers, Buffalo
James H. DeLaPlante III, Project Manager	U.S. Army Corps of Engineers, Buffalo
Joan Pope, Coastal Section	U.S. Army Corps of Engineers, Buffalo
Jon Brown, Economics Section	U.S. Army Corps of Engineers, Buffalo
John Lakatosh, Environmental Section	U.S. Army Corps of Engineers, Buffalo
Albert Fulco, Hydraulics Section	U.S. Army Corps of Engineers, Buffalo
Gary Buck, Regulations Branch, Toledo	U.S. Army Corps of Engineers, Buffalo
Howard W. Hill, Jr.	U.S. Fish and Wildlife Service, Cedar Point
Diane H. Wang, Staff Biologist	U.S. Fish and Wildlife Service, Columbus, Ohio
James Rickenberg	U.S. Soil Conservation Service
Charles Carter	ODNR, Div. Geological Survey, Sandusky
Jonathan Fuller	ODNR, Div. Geological Survey, Sandusky
Fred B. Ball	ODNR, Office of Chief Engineer, Columbus
Dennis Russel	ODNR, Div. of Watercraft, Sandusky
Clifton C. Moore	ODNR, Div. of Watercraft, Sandusky
George Wilson	Lucas County Engineer
James Woodward	Lucas County Drainage Engineer
Carol Butz	Toledo-Lucas County Planning Comm.
William Carstensen	Lucas County Soil & Water Cons. Dist.
Thomas Schultz	Toledo Metropolitan Area, Council of Governments
John Henning	Jerusalem Township Trustee
Richard Smarkel	Jerusalem Township Trustee
Joan Schabel	Jerusalem Township Clerk
Roger Van Hoose	Lake Erie Conservancy, Dist. No. 1
Charles O. Smith	Lake Erie Conservancy, Dist. No. 1
Daniel L. Warner	Howard Farms Conservancy District
Robert Stieben	Howard Farms Conservancy District
Anthony J. Horvath	City of Oregon

ORIENTATION WORKSHOP
FOR
WESTERN LAKE ERIE SHORE FEASIBILITY STUDY, OHIO
WEDNESDAY, 10 JANUARY 1979

ATTENDANCE (Cont'd)

Name	Representing
Niel M. Waterbury	Northwest Ohio National Resource Council
Beatrice J. Waterbury	League of Women Voters
Alice Geisel	Northwest Ohio National Resource Council
Hugh Gunderson	Northwest Ohio National Resource Council
Charles Ginsburg	Northwest Ohio National Resource Council

SUMMARY MINUTES
FOR
ORIENTATION WORKSHOP
ON
WESTERN LAKE ERIE SHORE FEASIBILITY STUDY, OHIO
THURSDAY, 11 JANUARY 1979

1. An Orientation Workshop concerning the Western Lake Erie Shore, Ohio, Study, was held at 1 p.m. on 11 January 1979, at the Oak Harbor Council Chambers, Oak Harbor, Ohio. The study deals with the feasibility of providing for beach erosion control, flood protection, and related purposes in the study area. The purpose of this Workshop was to inform public officials and other principal interests in Ottawa County of the study and to solicit their views on water resources problems and needs in the study area. This input on problems and needs is instrumental in scoping the future study effort and will be incorporated into the Reconnaissance Report currently underway.

2. John Zorich, Chief of the Western Basin, welcomed all present and opened the meeting with self-introduction. Discussion of the Western Lake Erie Shore Study was initiated with a review of the Committee Resolution requested by Honorable Delbert Latta on 11 April 1974. The proposed Corps of Engineers program and study schedule, including progress to date, was then presented and the Corps of Engineers study process was explained in more detail as outlined in an information package that was given to Workshop participants. A list of Workshop attendees is provided at the end of these minutes.

3. Subsequently, Mr. Zorich discussed previous Corps of Engineers studies and completed projects located within the study area. Information was also provided as to current Corps of Engineers activities, namely current studies and authorized projects. Maps of the shoreline area between the Ohio-Michigan line and Marblehead, Ohio, depicting this information was also provided to workshop participants as part of the information package.

4. A brief slide presentation of the shoreline was made by the Project Manager, James H. DeLaPlante III. The purpose of the slide presentation was to acclimate the audience and the Corps Interdisciplinary Team for this study to the geographical and topographical characteristics of the shoreline within the study area, especially the Ottawa County shoreline and problem areas.

5. Mr. Donald Guy of Ohio Department of Natural Resources (ODNR), Geological Survey, explained that a Lake Erie Shore Erosion and

EXHIBIT 2

Incl 2

Flooding Report for Ottawa County is being prepared and should be completed late in 1979. A similar report has been released for Lucas County Erosion and Flood Inundation Problems.

6. Mr. Michael Wolfson from Ottawa Planning Commission explained the CZM program and the program's present status. The Main Coastal Zone Management (CZM) report, of which Ottawa County is a part, is expected to be published in March or April of 1979.

7. Some areas of potential problems were discussed with respect to erosion and flood inundation from high Lake Erie levels and wave runup. Some areas that were identified are:

a. The typical low-lying shore from Locust Point east to the Rock Ledge area on Catawba Island. These low-lying areas experienced flood inundation during the 1972 and 1973 events.

b. The Portage and Toussaint Rivers experience lake effect conditions during high lake levels which affect the interior of Ottawa County, primarily widespread agricultural inundation. Some of the major highways affected by flooding by these river systems are Routes 2 and 590. Because of the lack of relief in the area, flood inundating waters eventually become trapped behind the diking system, thus requiring flooded areas to be pumped out.

c. Hazard to boating at the entrance to Turtle Creek.

d. The northeast corner of Middle Bass Island and at Put-in-Bay where there are some shore erosion problems.

e. The Sand Beach and Long Beach areas are prone to flooding. The county has placed a moratorium on construction in these areas.

f. There are areas of shore erosion all around Catawba Island. However, these areas are all privately-owned residential areas.

g. Port Clinton question of shore placing of dredged material.

The participants were also asked to contact James H. DeLaPlante III of the Buffalo District by mail or by phone if they thought of other water resource problem areas (shoreline erosion of public lands, flood inundations caused or aggrevated by high Lake Erie levels, etc.) after the meeting.

8. Mr. Zorich stated that the Buffalo District is planning to conduct a Public Meeting on the Western Lake Erie Shore Study in the spring of 1979. Hopefully, the information provided by interested officials and the general public at the Workshop and that the

upcoming Public Meeting will enable the Corps to establish a study effort along this 50-70 mile reach of Lake Erie consistent with the problems and needs of the affected area and the authorizing resolution for the study.

9. Mr. Carl Ruff of Ottawa County Cooperative Extension Service, gave a brief slide presentation on the Ottawa County Flooding during the 1972 and 1973 storms.

10. Closing remarks were made by Mr. John Zorich, thanking all present for their participation in the Workshop, and informing participants that copies of the summary minutes of this meeting would be sent to them for information, review, and comments.

12. The meeting adjourned at 4 p.m.

JAMES H. DeLaPLANTE III
Project Manager

ORIENTATION WORKSHOP
ON
WESTERN LAKE ERIE SHORE FEASIBILITY STUDY, OHIO
THURSDAY, 11 JANUARY 1979

ATTENDANCE

Name	Representing
John Zorich, Chief, Western Basin	U.S. Army Corps of Engineers, Buffalo
James H. DeLaPlante III, Project Manager	U.S. Army Corps of Engineers, Buffalo
Joan Pope, Coastal Section	U.S. Army Corps of Engineers, Buffalo
Jon Brown, Economics Section	U.S. Army Corps of Engineers, Buffalo
John Lakatosh, Environmental Section	U.S. Army Corps of Engineers, Buffalo
Albert Fulco, Hydraulics Section	U.S. Army Corps of Engineers, Buffalo
John McCarthy, Resident Engineer, Toledo Office	U.S. Army Corps of Engineers, Buffalo
Gary Buck, Regulations Branch, Toledo	U.S. Army Corps of Engineers, Buffalo
Howard W. Hill, Jr.	U.S. Fish and Wildlife Service Cedar Point
Diane H. Wang, Staff Biologist	U.S. Fish and Wildlife Service Columbus, Ohio
Robert Ball	U.S. Soil Conservation Service
Doyle F. Sommer	U.S. Soil Conservation Service
Donald Guy	ODNR, Div. Geological Survey Sandusky
Carl Hopfinger	ODNR, Div. Geological Survey Sandusky
Carl F. Ruff	Cooperative Extension Service
Michael Wolfson	Ottawa Regional Planning Commission
John Banghman	Ottawa County Health Department
Willard Bloom	Mayor, Oak Harbor
Lauren Milbrodt	Benton Township Trustee
Marvin Tabbert	Benton Township Trustee
William Hirt	Danbury Township Trustee
William Fritz	Catawba Island Trustee
Francis M. Burkhart	Catawba Island Trustee
Paul H. Rofkar	Catawba Island Trustee
William L. Darr	Bay Township Trustee
Charles Hopfinger	Bay Township Trustee
Marian J. Sinkey	Sand Beach Conservancy District

Ref: Our L-1834
DACW 49-79-C-0038
MAUMEE BAY STATE PARK EROSION PROTECTION

Minutes to Orientation Workshop held August 29, 1979 at ODNR office, Fountain Square, Building D, Columbus, Ohio.

Persons Present

See Sign Up Sheet

The orientation meeting was held to coordinate between the Corps of Engineers, ODNR, U.S. Fish and Wildlife Service and Moffatt & Nichol, Engineers, the desires and needs for the Maumee Bay State Park Development with the preparation of the Stage II Interim Preliminary Feasibility Report for Beach and Shoreline Erosion and Flood Control at Maumee Bay State Park, Ohio.

Introduction by Charles Gilbert. Explained the present position in the study process as the Stage II Interim Preliminary Feasibility Report based on a prior Reconnaissance Report prepared by the Detroit District. Moffatt & Nichol, Engineers was retained under contract by the U.S. Corps of Engineers to prepare certain sections of the present study, specifically, possible designs, preliminary designs, cost estimates, economic evaluation.

Planning Process was presented by John Zorich (Corps of Engineers). The Maumee Bay State Park Study was an accelerated portion of a larger study, the Western Lake Erie Shore Study. The present study objectives are to examine a range of reasonable alternatives and reduce to about two or three alternatives for further study. Congressional authorization will be ultimately required for construction. Moffatt & Nichol will identify ranges of possible alternatives and perform evaluations on about 6 alternatives. The present study will include three workshops including the orientation workshop. The orientation workshop is to establish a range of possible alternatives; the 1st iteration workshop is to reduce the number of alternatives to about 6 (including no-action); the 2nd iteration workshop will review the evaluations of the alternatives chosen in the 1st iteration workshop.

Study Needs presented by Kimo Walker is basically existing physical information in the project area (historical shoreline aerial photographs, topography, soils) and beach needs and demand.

Master Plan The park master plan was presented by Roger Hubbell. Phase I of the plan envisions 3,000 ft. of beach area, overnite camping use and day use for picknicking. Plan is presently in a land use allocation stage and details for drainage etc. have not been worked out.

EXHIBIT 3

Boating facilities potential would be studied after the park is developed. Is not a major consideration for the present study.

Nature Area is to be considered as an integral part of the park development. The state wants to preserve the area for its interpretive value. The state presently does not plan to manage the area to promote any specific species of wildlife and does not plan to regulate water levels with the area.

Soils information is available from Division of geological survey in Sandursky.

Traffic report. John Zorich (C of E) inquired on the status on the traffic report and requested two copies of the report when it is complete. James Swartzmiller says the traffic report gives projected peak traffic in the Maumee area, but does not identify the draw area of the park.

Draw Area for parks on Lake Erie is a great distance. ODNR expects a large percentage of users to be from the metropolitan area of Toledo. Overnite camping facilities will draw people from all over the state. Guess the 90% of park users would use the beach.

Swimming Kimo Walker brought out the question as to whether or not the shallow offshore depths in the area would limit the value of Maumee as a swimming beach. ODNR responded saying that there presently is bathing in the area and that the depths are not a problem.

Plans Kimo Walker presented a few conceptual plans for comments & suggestions.

No-Action Plan - ODNR's position is that the park development is contingent on erosion protection for the entire reach of shore. $1.5 million in federal funds was already tied up in the acquisition of park land. Source of money was the Federal Land & Water Conservation Fund.

Headlands, Detached Breakwaters, Protective Beach, and Groin Field alternatives were presented by Kimo Walker without much comments. Beach solutions were compatible with desires for park development.

Floating breakwaters and a perched beach were mentioned by Kimo Walker as not being suitable for conditions at Maumee.

Revetment and Swimming hole alternative for the western side of the Park was rejected on the grounds that it isn't compatible with the park development.

Nature Area Erosion control measures presented were protective beaches with or without retaining devices, low berm, sheet pile sea wall and a high dike. Diana Hwang (U.S. Fish & Wildlife Service) thought that allowing some wave activity may be beneficial in allowing marsh succession and wider diversity. Was unaware on any policy to promote one type of habitat over another.

The high dike was not desired for protecting the nature area. ODNR's position on the nature area is to create a wildlife interpretive area which is an integral portion of the park development. The area should be natural, diverse, and typical to the area. Are not planning to manage area or encourage any particular species.

Benefits Charles Gilbert (C. of E.) inquired whether user days can be estimated if portions of the park is not developed. Don Olson & James Swartzmiller reiterated that the park development was one complete entity and could not be separated into a beach area and nature area.

Position Paper John Zorich (C. of E.) requested a letter from Don Olson on ODNR's position and philosophy for the multi-use park on the Lake Erie Shoreline and the justification used for obtaining federal funds to acquire the Maumee Bay State Park Land.

Agreements with National Wildlife Refuge *There is presently* only an informal agreement to leave a buffer zone along the boundary line between Cedar Point National Wildlife Refuge and the park.

Time Schedule Compground construction should start construction in about 30 days (J. Swartzmiller). Development of the remainder of the park is dependant on the creation of a beach. Would expect 75% of visitation capacity. on the day after the beach is opened and 90% within 5 years.

Without Federal action - the area would remain as a campground and wildlife area.

Study Schedule The 1st iteration workshop was mutually agreed upon to be held on September 21, 1979 at 1:00 pm at ODNR Fountain Square, Building D, Columbus, Ohio. September 19 was set as an alternate.

MEETING

MAUMEE BAY STATE PARK EROSION PROTECTION

FOUNTAIN SQUARE, BUILDING D

COLUMBUS, OHIO

WEDNESDAY, 29 AUGUST 1979

1:00 P.M.

NAME	TITLE	ORGANIZATION
Diana Hwang	Biologist	U.S. Fish & Wildlife Se
Denton Clark	Chief, Coastal Ser.	NCBED
John Zorich	Chief, Western Basin	U.S. Corps of Engineer:
Charles Gilbert	Chief, Planning Branch	U.S. Corps of Engineer:
Eric H. Metzler	Operations Manager	Division of Watercraft
Tony Eelman	Project Manager	Corps of Engineers
Kimo Walker	Coastal Engineer	Moffatt & Nichol, Engr:
Roger Hubbell	Ass't. Chief Outdoor Recreation Services	ODNR
Wayne Warren	Admin.-Planning Section Recreation Services	ODNR
Arthur Shak	Coastal Engineer	Moffatt & Nichol, Engr
Bob Lucas	Governmental Agency Coordinator	ODNR
James Swartzmiller	Chief Engineer	ODNR
Don Olson	Chief, Outdoor Recreation Services	ODNR

Ref: Our L-1834
DACW 49-79-C-0038
Maumee Bay State Park Erosion Protection

September 21, 1979

INITIAL ITERATION WORKSHOP - MINUTES

An initial iteration workshop was held September 21, 1979, at the ODNR office, Fountain Square, Building D, Columbus, Ohio.

Persons present are shown on the attached sheet.

John Zorich (C. of E.) gave an overview of the study process and the orientation workshop held previously on August 29, 1979.

Kimo Walker (M&N) discussed possible alternatives that Moffatt & Nichol had provided in letters to the persons present, dated September 7, 1979. Explained that objective of this meeting was to eliminate alternatives which would be unacceptable from further study.

James Swartzmiller (ODNR) explained that the present method of showing alternatives with different types of erosion protection for the west and east sides of the park is not acceptable. Dividing the park into passive use on the east side and active usage (high usage) on the west side, would cause the two sides to be treated separately in the economic evaluation and not as one entity. Prefers to see one type of erosion protection along the entire shoreline of the park. Acknowledges that a beach is desired for the western end of the park, but does not want to eliminate the evaluation of rubble revetment or bulkhead alternatives along this reach on that basis.

John Zorich (C. of E.) mentioned that Corps policy may require that the project be evaluated on an incremental basis, but that they are approaching the study with an open mind.

James Swartzmiller (ODNR) mentioned that the temporary sewage treatment plant shown on ODNR's park master plan does not exist. At Crane Creek, the State of Ohio had to pay for protecting the wildlife area which he considers more valuable to the people of Ohio than a recreational beach.

No decisions could be made on alternatives which could be eliminated from further study except the headlands concept, which was eliminated on the basis that it may create a potential safety hazard for children.
Fish & Wildlife expressed that rubble mound structures would be preferable to vertical sheetpile type structures if economically feasible.

It was decided that the Corps of Engineers would make a policy decision on how to evaluate benefits of the passive vs. the active portion (proposed) of the park before alternatives for further study could be selected. Moffatt & Nichol would proceed with the littoral drift analysis and background write-up for the feasibility report.

EXHIBIT 4

MAUMEE BAY STATE PARK
FEASIBILITY STUDY
INITIAL ITERATION WORKSHOP
FRIDAY, 21 SEPTEMBER 1979

Name	Title	Organization
Bob Lucas	Governmental Agency Coordinator	ODNR
John Zorich	Chief, Western Basin	Corps of Engineers
Arthur Shak	Coastal Engineer	Moffatt & Nichol
David Hanselmann	Planner	ODNR - CZM
Mary Ellen Rusnor	Biologist	U.S. Fish & Wildlif Service
Diana Hwang	Biologist	U.S. Fish & Wildlif Service
Tony Eelman	Project Manager	Corps of Engineers
Kimo Walker	Moffatt & Nichol	
Wayne Warren	Outdoor Recreation	ODNR
Roger Hubbell	Asst. Chief - Office of Outdoor Recreation Services	ODNR
James Swartzmiller	Chief Engineer	ODNR

MEETING

MAUMEE BAY STATE PARK FEASIBILITY STUDY

SECOND ITERATION WORKSHOP

FOUNTAIN SQUARE, BUILDING D

COLUMBUS, OHIO

WEDNESDAY, 27 FEBRUARY 1980

1:00 PM

NAME	TITLE	ORGANIZATION
Anthony Eelman	Project Manager	Corps of Engineers
Denton Clark	Chief, Coastal Ser.	NCBED
John Zorich	Chief, Western Basin	U.S. Corps of Engineers
Diana Hwang	Biologist	U.S. Fish and Wildlife Service
Sharon Cooper	Economist	Corps of Engineers
James Swartzmiller	Chief Engineer	ODNR
Roger Hubbell	Ass't. Chief Outdoor Recreation Services	ODNR
Larry Henry		ODNR
Wayne Warren	Addmin.-Planning Section Recreation Services	ODNR
Christopher Lloyd	Coastal Engineer	Moffatt & Nichol, Engineers
Kimo Walker	Coastal Engineer	Moffatt & Nichol, Engineers
Buzz Collins		Geological Survey
Don Liddell		Corps of Engineers

SECOND ITERATION WORKSHOP - MINUTES

A second iteration workshop was held 27 February 1980, at the ODNR office, Fountain Square, Building D, Columbus, Ohio.

An attendance list is shown above.

John Zorich (C. of E.) stated the general purpose of the meeting: to obtain feedback from ODNR regarding the three alternatives.

Kimo Walker (M&N) described each of the alternatives in detail and fielded questions and comments from the floor.

James Swartzmiller (ODNR) questioned the integrity of the concrete retaining wall should the sand berm be washed out. Discussion among the group resulted in the decision to eliminate the retaining wall concept in favor of a storm dune with vegetation cover.

EXHIBIT 5

James Swartzmiller (ODNR) stated that the runoff through the proposed park must be maintained. Choices included: 1) protection and/or maintenance of existing ditches, and 2) relocation of the ditches. For this preliminary design phase, it was agreed upon to provide jetty protection of the ditches in each alternative.

James Swartzmiller (ODNR) was also concerned about the possibility of toe scouring along the revetment.

Denton Clark (C. of E.) suggested covering the toe with a layer of "A" Stone. Kimo Walker (M&N) agreed and will implement the changes.

Roger Hubbell (ODNR) questioned the inclusion of two gaps along the revetment, feeling that one would suffice. Don Liddell (C. of E.) opted to leave two gaps until future studies are made.

Buzz Collins (Geological Survey) was present for a portion of the meeting and proposed to profile nearshore areas within range of the project in an attempt to find a suitable low cost source of sand. Don Liddell (C. of E.) agreed that a general sand study may be worthwhile, however, it should not be set as a necessity for this preliminary design stage.

Kimo Walker (M&N) informed everyone that the cost and benefit analysis would be modified to conform with CORP specifications. Most notably, the unit rock prices will increase to reflect the use of a quarry approved by the CORP.

James Swartzmiller (ODNR) felt the beach nourishment figures were low on Alternative 2. Kimo Walker (M&N) agreed to reconsider the nourishment figures and adjust if warranted.

Don Liddell (C. of E.) was concerned with the use of the same amount of sand fill on Alternatives 2 and 3. Don felt the breakwater design should have eliminated a portion of the sand needed to prevent overtopping. Kimo Walker (M&N) agreed to recheck the analysis used and lower the elevation of the sand berm if warranted.

NCBED-PW

5 February 1981
Revised 1 April 1981

MEMORANDUM FOR RECORD

SUBJECT: Maumee Bay State Park Orientation Workshop Meeting for FFR

1. An orientation workshop for the Final Feasibility Report at Maumee Bay State Park was held 30 January 1981 at ODNR offices, Fountain Square, Columbus, OH. The purpose of the meeting was to review the plans recommended in the Stage 2 Feasibility Report and to discuss study direction in Stage 3.

2. Attendees at the meeting are shown on sheet 5, following.

3. Don Liddell made the opening remarks after which Dick Mammoser reviewed the four alternatives considered after the Second Iteration Workshop. These alternatives which were described in some detail were:

a. No Action

b. Alternative No. 2, Protective Beach, Revetment and Jetties. This is the basic plan and its features are commmon to other structural alternatives.

c. Alternative No. 3, Protective Beach with Detached Breakwaters and Jetties to the west and Revetment to the east. This is the preferred plan as it would provide the most stable beach.

d. Alternative No. 4, Protective Beach, with Groin Field and jetties to the west and Revetment to the east. This alternative has been eliminated for the following reasons:

(1) Allows excessive offshore sand losses.

(2) Hazardous to children because of scour around the groins.

(3) Most disruptive to littoral currents.

(4) Most costly alternative.

4. First Costs and Annual Charges were given for Alternatives 2 and 3. It was noted that the figures presented in the report were those of the Consulting Engineer, Moffatt and Nichol, and the totals included their Nourishment Quantities. The District's Coastal Section provided their estimates of offshore losses which are 30,000-45,000 cy for Alternative 2 and 10,000-20,000 cy for Alternative 3. Based on the lower figure of the range priced at $9/cy, the revised annual costs would be $927,000 for the Protective Beach (Alternative 2), and $866,000 for the Protective Beach with Breakwaters (Alternative 3). Moffatt and Nichol computed the B/C ratios as 2.4 and 2.2 for Alternatives 2 and 3, respectively. The revised Nourishment

Quantities were given to show the sensitivity of the annual costs to same. Based on this analysis, the District would probably recommend going with Alternative 3, the Protective Beach with Breakwaters. It would be too much of a gamble to construct the Protective Beach without additional protection and monies spent on offshore losses would be non-recoverable.

5. The District did consider a staged type of construction wherein the Protective Beach would be constructed and observed for several years after which time Detached Breakwaters would be added, if necessary. This option was later dropped because of authorization and funding problems.

6. Roger Hubbell asked why there was such a discrepancy between Moffatt and Nichol nourishment figures and the Corps. It was stated that this determination is judgemental, based on past experiences with similar situations. Maumee Bay is unique and identical sites are nonexistent.

7. Three plans will be carried forward to Stage 3. They are:

a. No Action (Alternative 1 from Stage 2).
b. Protective Beach and Revetment (Alternative 2 from Stage 2).
c. Protective Beach with Detached Breakwaters and Revetment (Alternative 3 from Stage 2).

8. Bob Lucas asked about the schedule for Stage 3. The current CPM shows the Draft FFR date of *December* 1981 with the Division Engineer's Notice in December 1982. Board action would take place in mid 83 and the project could be submitted to Congress by the end of 1983. Phase II GDM, and plans and specs would take about 2 years and construction could begin in the spring of 1986, based on the above assumptions made by the District.

9. Discussion ensued on Coastal efforts during Stage 3. Tom Bender stated that several Littoral Environmental Stations (LEO) would be established. In addition, a trial dump (one or two loads) of sand might be helpful. Ron Kus said his people at the park could probably assist in this monitoring.

10. Jim Swartzmiller asked about the source of sand. Tom Bender stated that there is a large supply of sand off Cedar Point. This source will be considered including pumping of same. Another source is at Marblehead, Ohio. Don Liddell stated that a permit would be required if Cedar Point was chosen for the source. Kent Kroonemeyer said that he would not expect any major problems with obtaining sand from Cedar Point. Jim Swartzmiller stated that the locals are looking for a source of sand and if an offshore site is opened up they might also want to use this source. Don Liddell stated that this usage could be controlled. Coastal Section will provide a map to the F&WL of Cedar Point so that they can investigate this possible source.

11. The depth of water at Maumee was discussed. If the breakwaters were constructed as suggested by Moffatt and Nichol they would be at LWD - 3 feet

NCBED-PW
SUBJECT: Maumee Bay State Park Orientation Workshop Meeting for FFR

which would give a depth of about 6 feet of water during the summer. Tom Bender said that they are considering moving the breakwaters closer to shore, which would make construction by water infeasible.

12. Jim Swartzmiller said that ODNR is doing some prototype testing of breakwaters at East Harbor State Park and asked if the Corps would be interested in participating. Don Liddell responded that we might be able to participate in the study but not in the construction. Construction of these breakwaters is expected to get under way in July 1981.

13. Don Liddell noted that there was a difference of opinion on whether ODNR's park development costs should be included in our project costs. OCE said that they need not be included as they were considered self liquidating but NCD was still checking as they felt they should. If at a later date it is agreed that they be included, ODNR will be asked to provide information on the recreational benefit associated with the various park facilities.

14. Don Liddell stated that it was decided at the Checkpoint Conference that the Corps participation in the cost of beach construction would be limited to a width necessary to prevent shoreline erosion. Any width beyond this would not be cost shared but the cost thereof would be 100 percent non-Federal. To offset the sponsor's additional cost we are suggesting moving the beach landward up to 100 feet, thereby reducing the total amount of sand required and offsetting some of ODNR extra cost. If the beach were built 100 feet further landward than originally planned, ODNR would lose about 10-12 acres of parkland. ODNR stated that this would not be a problem. However, they suggested that 50-80 feet of grassy area could be constructed in lieu of beach, on the landward side. The District stated that this modification could be accomodated in the design.

15. Director Teater stopped in at the meeting. After a briefing of some of the problems he asked why it takes so long to get a project to construction. The Corps process to construction was explained.

16. A discussion ensued on parking requirements. It was agreed that ODNR would construct sufficient parking for full beach usage as the beach is constructed. Buffalo District informed ODNR that their contemplated schedule of future park development would be required to estimate project benefits. ODNR should provide this information in the near future.

17. Quality of water was discussed. ODNR stated that they can only control park discharges and not that from drainage ditches. ODNR requested that Item 6 of local cooperation be revised to reflect control of pollution from the park only. The District concurred. Other agencies are responsible for this. Water quality when last tested was satisfactory for water contact.

AD-A138 420 MAUMEE BAY STATE PARK OHIO SHORELINE EROSION BEACH RESTORATION STUDY FINA..(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT DEC 83 4/6

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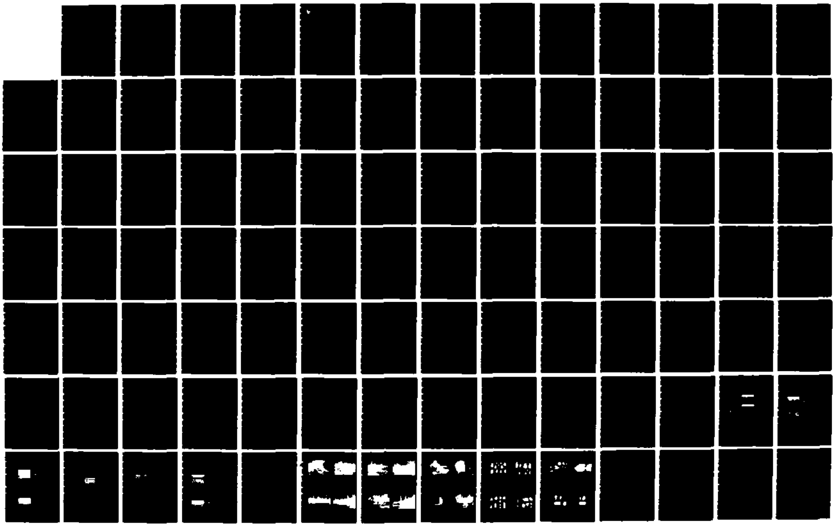

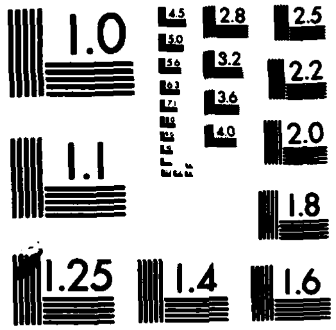
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NCBED-PW
SUBJECT: Maumee Bay State Park Orientation Workshop Meeting for FFR

18. Discussion took place on turbidity. Concern was expressed that the clay bottom when disturbed would create turbid water which would be objectionable to swimmers. In addition, if silt and clay settled on the beach when washed ashore by waves they would leave a mud residue. No one had a solution to the problem but it was agreed that this potential problem should be investigated and discussed in Stage 3.

19. The Stage 2 report overestimates the number of picnic tables as ODNR is only planning on placing 450 tables.

20. Meeting adjourned at 4:00 p.m.

RICHARD MAMMOSER
Study Manager
Western Basin

Maumee Bay State Park - 1/30/80

Attendees

R. Mammoser	Study Manager, USACE
T. Bender	Coastal Engineer - Buffalo District
D. Liddell	Chief, Engr. Division - Buffalo District
Bob Lucas	ODNR - Government Agency Coordinator
Ronald T. Kus	ODNR - Parks and Recreation
Wayne Warren	ODNR - Outdoor Recreation Service
Kent E. Kroonemeyer	U. S. Fish & Wildlife Service
Diana Hwang	U. S. Fish & Wildlife Service
Bill Butler	Environmental - Buffalo District
John Zorich	Planning Branch - Buffalo District
Roger Hubbell	Chief, Outdoor Recreation Service, ODNR
Fred Ball	Engineer - Office of Chief Engineer ODNR
James Swartzmiller	ODNR - Chief Engineer

APPENDIX G
FINAL FISH AND WILDLIFE COORDINATION ACT REPORT

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
AH/EMW

AUG 3 1982

Colonel Robert R. Hardiman
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Hardiman:

This is our Final Fish and Wildlife Coordination Act Report on Maumee Bay State Park Shoreline Erosion Study in Lucas County, Ohio. Our comments on the proposed project have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and in compliance with the intent of the National Environmental Policy Act of 1969. A preliminary Fish and Wildlife Coordination Act report on the Western Shore of Lake Erie, Ohio, Beach Erosion Control and Flood Damage Prevention Study was submitted to the U. S. Army Corps of Engineers, Buffalo District in November of 1979. This report updates our interim Fish and Wildlife Coordination Act report dated April 1980 and draft Fish and Wildlife Coordination Act report dated December 1981 on the Western Shore of Lake Erie, Ohio, Maumee Bay State Park Shoreline Erosion Study. This report has been reviewed by Ohio Department of Natural Resources, Divisions of Wildlife and Parks and Recreation. Their letters of concurrence dated July 30 and August 6, 1982 have been included in this report.

PROJECT DESCRIPTION

The purpose of the project is to provide shore protection to a section of critically eroding shoreline of Lake Erie within what is known as the "western basin of Lake Erie". The project would be located approximately four miles east of the mouth of the Maumee River. The project is part of the Ohio Department of Natural Resources' (ODNR) plan to develop Maumee Bay State Park, a 1,241-acre recreational waterfront area, for multiple uses. The state-owned lakeshore is approximately 11,000 feet in length and is located between Norden Road and Cousino Road, immediately to the west of Cedar Point National Wildlife Refuge (NWR) and includes the area designated on U. S. Geological Survey topographic maps as Niles Beach (Figure 1).

Facilities for camping, picnicking, lodging, golfing, swimming, environmental education, and other day uses are integral components of the state's planned "total park" concept. The State has already purchased the necessary lands along the shore and is in the process of acquiring additional adjacent inland areas. However, the state's shorefront property lies in a high erosion rate area. Recession rates along the park shoreline generally range from 7.0 to 14.5 feet per year. It has been estimated by

Benson (1978) that the shoreline will recede another 450 feet by the year 2010 if left unchecked. This would reduce the size of the park and its recreational value.

Representatives of the U. S. Army Corps of Engineers, U. S. Fish and Wildlife Service, ODNR, and Moffat & Nicole Engineers (M&N) attended meetings in the fall of 1979, spring of 1980, and spring of 1981. The purpose of the meetings was to consider, discuss, develop, and screen numerous management measures and possible alternatives. Five basic plans have been developed for consideration by the U. S. Army Corps of Engineers. Preliminary engineering plans were presented during interagency meetings. Three of the five plans involved erosion control structures and a beach replenishment program. One plan involved only erosion control structures. One plan is a no-action plan. A brief description of each alternative is presented below.

Alternative 1 - No Action

The no-action plan serves as a baseline condition for evaluating possible alternatives. It has been estimated by M&N that continued erosion at the present recession rate would claim approximately 140 acres of shorefront park property in 50 years. This alternative would not satisfy State planning objectives.

Alternative 2 - Beach and Revetment

The beach and revetment concept would provide a recreation beach composed of medium-sized sand along the western half of the area and a rubble revetment along the eastern half of the project area. The beach would be approximately 250 feet wide by 5,500 feet long and built to an elevation high enough to prevent overtopping by storm waves during high lake levels. Plans also call for a 5,500-foot long concrete retaining wall along the western half of the project area to prevent beach sand from being lost to inland areas during a storm; however, backfilling the beach sand with soil to form a "storm dune" is also being considered. If the concrete retaining wall is used, modification of the wall to provide a promenade could be made. Periodic sand nourishment and back-passing would be required to maintain the beach. One 450-foot long jetty and one 250-long jetty would need to be constructed to protect two ditch openings from blockage by sediments.

The 5,500-foot long rubble revetment would be designed to provide erosion protection to the natural swamp-marsh area located on the eastern half of the park. The structure would be approximately eight feet above low water datum (LWD), thereby allowing water to occasionally overtop the structure. In response to our concern and to maintain a drainage easement for Anderson Ditch, at least one gap along the length of the revetment will be left open to allow water passage and fish movement between the lake and swamp-marsh.

Alternative 3a - Beach, Detached Breakwaters, and Revetment

The protective beach would be similar to that presented in Alternative 2. However, the beach would be protected from incident wave energy by the

construction of eight offshore breakwater structures. Each structure would be approximately 300 feet long, built of stone rubble, and located 800 to 1,000 feet offshore at a depth of three feet below LWD. Positioning of the breakwaters could eliminate the need for end jetties. The rubble revetment along the eastern half of the shoreline would be constructed similar to that presented in Alternative 2.

Alternative 3b - Beach, Detached Breakwaters, and Revetment

The design would be similar to that presented in Alternative 3. The only major alteration in this alternative would be the reduction of beach width from 250 feet to 200 feet. The loss of beach area would be substituted with an equal area of grass.

Alternative 4 - Beach, Groins, and Revetment

The protective beach would be similar to that presented in Alternative 2. However, four groins would be constructed perpendicular to the incident wave energy, thus reducing the longshore littoral transport of sand. Each groin would be approximately 450 feet long and constructed of quarry stone. The two jetties and 3,500-foot long rubble revetment would be constructed similar to those presented in Alternative 2.

Alternative 5 - Revetment

This alternative would provide a revetment across the entire 11,000 feet of shoreline. The structure would have gaps to allow drainage from ditches and to allow water passage and fish movement between the lake and wetland. At the eastern end of the park, the structure would allow overtopping. No protection beach would be constructed.

Sand Source for All Alternatives

The proposed project requires the delivery of approximately 300,000 cubic yards of sand to the project area for the initial construction of the protective beach. The need for smaller but continuous quantity of sand at a rate of 1,000 to 10,000 cubic yards per year has been estimated for beach maintenance over the life of the project. Initially, the beach was proposed to be constructed of medium-sized sand delivered by truck from local sand and gravel operators. Now, use of fine-grained sand dredged and pumped to the project area from an offshore source is also being considered. Two areas, one off Cedar Point and another at Marblehead, were identified in a January 1981 interagency meeting as possible lake sources of sand. Figure 2 shows the general distribution of the Cedar Point sand source and location of two areas (Areas A and B) which would most likely be dredged if sand is to be obtained from this source.

DESCRIPTION OF RESOURCE

Physiography

Historically, the 1,241-acre area proposed for Maumee Bay State Park was part of the "Great Black Swamp," an extensive wooded wetland which extended

across 120 miles of northwestern Ohio. The western portion of the park (Figure 1, reach 16 to 19) was woodland, and the eastern portion (reach 19 to 23) was marsh. Maps from 1915 show the area as agricultural land. By 1940, a small residential area developed at Niles Beach (Figure 1, reach 16 to 19). The surrounding area continued to gradually change from woodland and marsh to agricultural land. However, flooding, erosion, high lake levels, and the abandonment of residential areas and farming caused certain areas to revert to marsh (Benson, 1978).

Langlois (1954) described the substrate of the nearshore zone as silty clay. The following excerpt from Benson (1978) provides a more detailed description of the geology at the site of Maumee Bay State Park:

> "Glaciolacustrine deposits are exposed in the nearshore zone along the Maumee Bay (western basin) shoreline east of profile 22. Northeast of Cedar Point, these deposits are very similar texturally to the Recent Muds, being rich in silt and clay with only minor amounts of sand and gravel..... Distribution of these deposits in the nearshore zone is determined by the topography of the glaciolacustrine deposits and the underlying fill."

The descriptions by Benson (1978), Langlois (1954), and Pincus (1960) of the nearshore substrate are consistent with our biologists' findings. The slope varies little beyond 50 feet from shore after an initial gentle drop to water about three feet deep. Aside from a rubble jetty located near Norden Road at the western end of the state-owned shoreline, the substrate is composed of silt, mud, and loam with a small amount of sand distributed homogeneously throughout the project area.

The U. S. Army Corps of Engineers (1945), described the offshore material at the project site as lacustrine clay with a thin overburden of recently deposited silt. Lacustrine clay measured up to 30 feet thick. The lake clay overlies Silurian dolomite. Pincus (1960) indicates mud, clay, and silt as occupying areas offshore of the project site. Data from numerous core samples have been taken throughout the Maumee Bay area by Herdendorf and Cooper and are available in their 1975 report.

Sand can be considered a limited resource in Lake Erie. Sand is notably lacking along the shore and within the immediate nearshore area of Maumee Bay State Park. A comprehensive study of known sand and gravel deposits within Ohio boundaries of Lake Erie was done by Hartley (1960) between 1953 and 1957. Hartley's (1960) study and a subsequent study by Williams et al. (1980) covered the same four major known sand deposits located at Cedar Point, Lorain-Vermilion, Fairport Harbor, and Maumee Bay. Herdendorf and Braidech (1972) investigated other areas off Ashtabula, Conneaut, Huron, and Sandusky, and in the island area.

The closest nearshore sand-rich deposit occurs immediately northeast of the project area and is referred to as the "Cedar Point spit" or "Maumee Bay sand deposit" (Figures 2 and 3). Figure 3 shows the general depth contours of the area of the Cedar Point spit and the location of three previously authorized permit dredging areas (Areas A, B, and C). This sand and gravel deposit was formed by littoral currents moving northwesterly along the

shore east of Cedar Point and marks an area of accretion. The deposit migrated in response to changes in water level, littoral drift, and significant storms before being stabilized by the construction of dikes around Cedar Point. Williams et al. (1980) offers the following description of the deposit:

> "The sand and gravel deposit is a low ridge widening from less than 0.5 mile at Little Cedar Point to more than two miles at its northern end near Turtle Island. On the western and northern sides, the deposit terminates abruptly with a rather sharp sand-mud boundary. Eastward the change to mud is indefinite and there is no mappable boundary."

> "The western and northern sides of the deposit are also relatively steep. The higher surfaces of the deposit rise to a maximum of about seven feet above the general bottom level. Turtle Island, actually a part of the deposit, rises a few feet above water level."

The majority of sand in the Cedar Point spit appears to be fine-grained. Based on sediment and core samples taken in Areas A and B (Figure 17 and Table 30 of Herdendorf and Cooper, 1975), medium and coarser material is present but very localized and apparently randomly distributed. Williams et al. (1980) indicates that there is a conspicuous lack of medium-grained sand in this deposit. Williams et al. (1980) surmises that the predominantly fine-grained nature of sand at this deposit may limit its use for beach nourishment.

The Cedar Point spit has been a commercial source of sand for concrete and masonry purposes. White Brothers Sand and Gravel was authorized from 1977 to 1980 to dredge for sand and gravel from Areas A, B, and C (Figure 3) at a rate of 100,000 cubic yards per year. However, Ohio Geological Survey records indicated that no quantity of sand over 7,600 cubic yards in any given year was removed from Maumee Bay since the permit was issued in 1977. Table 1 presents quantities of material taken from the Cedar Point spit area between 1958 and 1981. Since 1980, there has been no production from the area. With the expiration of White Brothers Sand and Gravel's Army Corps of Engineers permit to dredge the spit on December 31, 1980, no authorization presently exists to allow the dredging of Areas A, B, or C for sand or gravel.

An accurate calculation of sand volume at Cedar Point spit was precluded by poor seismic records and a lack of vibracore data during the Williams et al. (1980) study. Therefore, Hartley (1960) provides the most recent estimate of available sand resources based on field sampling for this area. Hartley (1960) estimated that the Maumee Bay spit contained 69,000,000 cubic yards of sand. Of this quantity, 6,000,000 cubic yards of material were estimated by Hartley to be of commercial quality, and 3,000,000 of the 6,000,000 were estimated to be commercial-quality sand lying in Areas A and B (Figures 2 and 3). From Ohio Geological Survey records in Table 1 provided by Collins (1980), 559,689 cubic yards of commercial grade material have been removed from the Cedar Point spit since Hartley completed field work in 1957. While this amount included material taken

from Area C (Figure 3), the majority of material was taken from Areas A and B (Collins, 1980). Therefore, it can be deduced that approximately 2,440,311 cubic yards of commerical quality material are present in Areas A and B.

Wave activity is less within the western basin than in open-lake areas. Several factors appear responsible: (1) the underwater extension of the Cedar Point spit receives the direct brunt of wave activity from the open lake and tends to partially shelter the southeastern part of Maumee Bay (Herdendorf et al., 1975); (2) the shallow, gentle sloping nature of the bay causes deeper water open-lake waves to break several times before they reach shore (Benson, 1978); and (3) the fetch distances within the western basin are less than those for the open-lake area.

Despite this reduced wave action, the project area is a critical erosion area and subject to flooding during severe easterly storms. Reach 16 to 18, (Figure 1) in the western half of the project area is consistently cited in recession rate reports for Lake Erie as one of the worst areas for erosion. Recession rates in Reach 16 to 18 have varied from 1.9 feet per year to 27 feet per year in the last 100 years. The long-term recession rate for this area is approximately 11.5 to 14.5 feet per year. These extreme recession rates have been attributed to the following factors: (1) the lack of a beach, (2) the lack of natural vegetative cover due to agricultural disturbances, (3) the low lying nature of the glaciolacustrine clay, (4) the lack of shore development and shore protection structures, and (5) the vulnerable orientation of the shoreline to northeastern storms. High lake levels were significant in increasing rates of erosion in 1973 and 1974. The lower rates west of transect station 20 (Figure 1) are apparently natural (Benson, 1978; Great Lakes Basin Commission, 1975).

No major streams, rivers, or tributaries are located within Maumee Bay State Park. However, five ditches are located in the park. Three of these ditches (McHenry, Berger, and Sautter) run in a north-south direction at one mile intervals. Two ditches (St. John and R. Ames) run through the park in an east-west direction. St. John Ditch connects Norden Road Ditch and Berger Ditch, and R. Ames Ditch runs midway through the park from Norden Road to Sautter Ditch (Figure 1).

Vegetation

The primary vegetation type of the park is old field. The area is in its fourth to sixth year of natural succession and supports a wide variety of grasses and broad-leaved herb species, including goldenrod, aster, wild carrot, teasel, yellow sweet clover, Canadian thistle, and mustard species. ODNR has begun the planting of saplings in the western portion of the park as part of camping site preparations.

Wetlands at Maumee Bay State Park lie in low relief areas at or near the mean elevation of Lake Erie. ODNR has estimated that approximately 250 acres of wetland exist near the shoreline in the eastern portion of the park. Figure 4 reproduces wetland information for the area available through U. S. Fish and Wildlife Service's National Wetland Inventory Survey (NWIS). The NWIS for the Maumee Bay State Park area is based on April 1977

aerial photographs of the area. Based on the NWIS, approximately 244 acres of palustrine wetland exist in Maumee Bay State Park. Approximately 178 acres of these wetlands lie adjacent to Lake Erie. Table 2 provides a breakdown of wetlands by proposed ODNR use and wetland type according to the Fish and Wildlife Service's Wetland Classification System (Cowardin *et al*., 1979). The Army Corps of Engineers, Permit Section, Buffalo District has field checked boundaries and made maps for park wetlands which fall within the Corps' jurisdiction under Section 10 of the River and Harbor Act of 1899 and/or Section 404 of the Clean Water Act of 1977. Wetland boundaries may be expanding westward and southward with lake encroachment and failure of man-made drainage works.

The majority of wetlands at Maumee Bay State Park are composed of areas of persistent emergents and broad-leaved deciduous forest species. Large areas of persistent emergents are primarily composed of cattail. Other persistent emergent species present, but not dominant in the area, include *Phragmites* spp., *Polygonum* spp., purple loosestrife, several varieties of bulrushes and sedges. Broad-leaved deciduous scrub-shrub species present, but not dominant in the area, include red osier dogwood, *Salix* spp., and young wetland associated trees. Dominant broad-leaved deciduous forest species and broad-leaved scrub-shrub species occupying wooded swamp areas include a variety of hardwoods common to bottomlands and floodplains. Red maple, cottonwood, sycamore, American elm, swamp white oak, green ash, box elder, red osier dogwood, and black willow are among the woody species which may be found in moist soil and swamp conditions in this area of the park.

Secondary growth vegetation can be found on slightly higher elevations along forest and swamp edges, roads, and ditches. The vegetation is typified by a variety of vines and shrubs, including dogwood, sumac, wild plum, honeysuckle, wild grape, blackberry, honey locust, hawthorn, and choke cherry.

No proposed federally endangered plant is currently listed as occurring in Lucas County. In a letter dated July 30, 1982, to the U. S. Fish and Wildlife Service, the Ohio Division of Natural Areas and Preserves notes the occurrence of silverweed, *Potentilla anserina*, at Maumee Bay State Park. The Ohio Natural Areas and Preserves indicates that *Potentilla anserina* is a rare, potentially threatened plant. A publication on rare and endangered aquatic vascular plants of Ohio has been written by Stuckey and Roberts (1977). The publication indicates that in the authors' opinion 33 aquatic plant species in Lucas County are either extirpated, endangered, or threatened.

Fish

A summary of the fisheries resource of the western Lake Erie shore is available in a preliminary Fish and Wildlife Coordination Act Report entitled Western Shore of Lake Erie, Ohio, Beach Erosion Control and Flood Damage Prevention Study, prepared by the U. S. Fish and Wildlife Service for the U. S. Army Corps of Engineers (USDI, FWS, 1979). The following section on fish summarizes existing fisheries information specific to the project area, the Cedar Point spit, and Maumee Bay.

Table 3 summarizes the works of Fraleigh et al. (1975), Pinsak and Meyer (1976), and Hartley and Van Vooren (1977) on fish species expected to occur in nearshore and offshore areas of Maumee Bay State Park and Little Cedar Point. Fraleigh et al. surveyed Scott and Crossman to develop a list of species expected to occur in Maumee Bay during the spring based on species present in Lake Erie. Pinsak and Meyer compiled a list of fish inhabiting Maumee Bay prior to 1957 based on Trautman (1957). Pinsak and Meyer then developed a list of fish believed to presently inhabit Maumee Bay. Hartley and Van Vooren compiled tables of habitat types used by Lake Erie fish species for spawning, nursery, feeding, migration, and overwintering (Tables 32 to 42 in USDI, FWS, 1979). Below each type of habitat was a list of fish species known to use that habitat. The list attributed to Hartley and Van Vooren in Table 3 was based on aquatic habitats available at Maumee Bay State Park and at the Cedar Point spit and Hartley and Van Vooren's tables on fish habitat preferences.

Table 4 presents a list of fish actually caught in Maumee Bay. Fraleigh et al. (1975) set gill nets in designated dredging Areas A and B of Maumee Bay in April and May of 1974. Sampling was conducted for 24 hours on April 27, for 21 hours on May 26, and for 11 hours on May 27. Herdendorf and Cooper (1975) conducted a bi-weekly sampling of larger fish in Maumee River and Bay between June and October of 1975. Two of six stations sampled were located in designated dredge Areas A and B. Herdendorf and Cooper conducted a tri-weekly sampling of larval fish in Maumee River and Bay between May and September of 1975. Mizera conducted ichthyoplankton surveys of Maumee Bay in 1977 using plankton nets. Two transects, one placed each side of and parallel to the Toledo Harbor navigation or shipping channel, were sampled. Each transect had three stations - two in water two meters deep and one in water three meters deep. Samples were collected between one hour after sundown to one hour before sunrise between April 14 to July 8, 1977. Samples were taken approximately every ten days, weather permitting. Table 5 reproduces Mizera's 1977 data of larval fish captures in western Lake Erie. A limited fisheries survey of the project site was conducted on July 26, 1979, by U. S. Fish and Wildlife Service biologists. All species were collected using a 100' x 6' x 1/4" mesh bag seine.

Several attempts have been made to map important spawning areas in the western basin for various fish species. Pinsak and Meyer (1976) developed one such map based on information by a commercial fisherman. Pinsak and Meyer suggested that the high catch of fish in a particular area indicated the existence of spawning beds for those fish caught at that particular locale but were careful to note that spawning areas identified in this manner were not to be considered the only locations for spawning by species caught. Pinsak and Meyer also noted high catch areas and possible spawning beds for white bass, gizzard shad, yellow perch, and walleye extending along each side of the Toledo Harbor navigation channel.

Hartley and Van Vooren attempted to map important nursery, feeding, migration, wintering, harvest, and special-use areas along the Ohio-Lake Erie shoreline as well as spawning areas (Plates 1a, 2a, 3a, 4a, 5a, and 6a in USDI, FWS, 1979). Hartley and Van Vooren's plates illustrate the

importance of the nearshore zone in Maumee Bay for spawning and the importance of the entire Maumee Bay basin as an important nursery, feeding, migration winter area for fish, and as important harvest and special use areas.

Herdendorf and Cooper (1975) found that catches throughout Maumee Bay were dominated by rough fish such as gizzard shad, carp, and freshwater drum. Gizzard shad, carp, and freshwater drum share the adaptation of producing offspring successfully under extremely turbid and degraded water conditions. Gizzard shad were dominant in Maumee Bay and Maumee River using both areas as spawning, nursery, and adult habitats. Of larval fish captured in the western basin of Lake Erie in 1977, gizzard shad larvae constituted 82.58 percent of the total catch (Mizera, 1981).

White bass, an important commercial and sport fish, has been considered primarily a river spawner (Cooper, 1981). However, there is evidence that white bass will also spawn on sand and gravel areas of Lake Erie. The shoal off Little Cedar Point has been identified as a major spawning area for this species (Goodyear, et al., 1981). Table 5 indicates a particularly large density of white bass larvae occurring in Maumee Bay when compared to other western basin locations sampled (Mizera, 1981). Herdendorf and Cooper (1975) have recorded white bass larvae densities as high as 108.47 larvae per 100 cubic meters of water from designated dredging Area A and 156.33 larvae per 100 cubic meters of water from designated dredging Area B in Maumee Bay.

The yellow perch is an important commercial and sport fish. Yellow perch spawn in shallow areas and need to attach their string of eggs to rooted vegetation, submerged brush, fallen trees or riprap. However, yellow perch will sometimes spawn and find sufficient attachment for their eggs over sand and gravel areas. Yellow perch larvae have been taken from the Cedar Point spit area by Herdendorf and Cooper (1975) and Mizera (1981). Mizera noted relatively high densities of yellow perch along the Ohio shoreline. Cooper (1981) has been working with yellow perch larvae data obtained from ichthyoplankton studies conducted in 1975 and 1976 in the western basin. He has noted an increase of yellow perch larvae density corresponding to the location of the Cedar Point spit in June of 1976.

The rainbow smelt is a schooling, piscivorous species inhabiting midwaters of lakes or inshore coastal waters (Scott and Crossman, 1973). Smelt is an important commercial fish to Canada. Most smelt spawning areas are located in Canadian, New York, and Pennsylvania waters of Lake Erie. Smelt will spawn in streams or in lakes. Moving in from the deeper waters which they inhabit through most of the year, smelt will spawn in shallow, nearshore areas of sand or offshore over sand and gravel shoals. Trautman (1957) noted the capture of larval smelt at islands and hypothesized that adults spawn over bars where there is a current. Herdendorf and Cooper (1975) and Mizera (1981) have both taken larval smelt from designated dredging Areas A and B of Maumee Bay (Table 4). Mizera believes the larvae drift in on currents of the Detroit River. Resolution of this controversy would depend on the location of capture of pro-larval forms.

Some walleye and sauger spawning occurs within Maumee Bay. Sauger spawning occurs in inshore waters along the south shore of Lake Erie, parcticularly near Maumee Bay. In 1977, pro-larvae and post-larvae were found in small numbers in early May and early June at the entrance to the bay, around Little Cedar Point, and between the point and the shipping channel. The spawning of walleye in Maumee Bay is not major when compared to the spawning activity found near the islands, reefs, and rocky shoals; however, Maumee Bay is an important nursery area for walleye. Mizera (1981) found high densities of walleye occurring along the Ohio shoreline. Walleye will feed over sand and gravel areas. (Herdendorf and Cooper, 1975; Pinsak and Meyer, 1976; Goodyear, et al., 1981; Mizera, 1981).

Spottail shiner is an important forage fish for major commercial and sport species and is frequently found in walleye stomachs. Spottail shiners spawn over clean sand or gravel areas in shallower portions of the nearshore zone. Herdendorf and Cooper (1975) and Mizera (1981) found spottail shiner larvae on designated dredge Areas A and B of Maumee Bay (Table 4). Table 5 clearly illustrates that the concentration of spottail shiner larvae corresponds to the availability of nearshore sand. The western basin is the major spawning and nursery ground for spottail shiner (Goodyear, et al., 1981).

Only a few of the major commercial, sport, and forage fish species for which existing information was available have been presented here. Of the 85 fish species in Lake Erie which depend upon the nearshore zone at some time during their lifespan, 54 species can make use of sand and gravel areas. Approximately 16 species have a critical need for exposed sand and/or gravel areas at some time during their lifespan. Table 6 presents a list of fish species and the purpose for which each species requires exposed sand and/or gravel habitat.

Mooneye (Hiodon tergisus) is listed by the Ohio Division of Wildlife as an endangered species. The species is sensitive to high turbidities and is rare in Lake Erie. The spawning area for this species is uncertain. Herdendorf and Cooper (1975) caught several larval mooneye on May 24, 1975, with an ichthyoplankton net in the western basin. The larvae were captured only one time at only one of the fifteen locations sampled in Maumee Bay from May 16 to September 3, 1975. Data relating to the capture of mooneye larvae is summarized in Table 7.

Other Ohio endangered species which may be found in Maumee Bay are indicated in Table 3. Species included are spotted gar, muskellunge, silver chub, greater redhorse, burbot, eastern sand darter, Iowa darter, and channel darter. Muskellunge are dependent on clear waters and abundant aquatic vegetation. Silver chubs have been captured by Herdendorf and Cooper (1975) in designated dredging Areas A and B. Eastern sand darter and channel darter have a critical need for exposed sand and/or gravel habitat at some time during their lifespan and may utilize the Cedar Point spit area (Table 6). No fish on the Federal (U. S. Department of the Interior) Endangered Species list are generally found in the Lake Erie nearshore zone.

Amphibians and Reptiles

No survey was conducted specifically for the purpose of identifying amphibians or reptiles in the area. However, the proposed park is within the ranges of 19 species of amphibians and 22 species of reptiles (Table 51 of USDI, FWS, 1979). Any of these species could be expected to occur within the proposed park given the proper habitat. The Ohio Division of Natural Areas and Preserves has records for the occurrence of fox snake, eastern garter snake, northern water snake, Blanding's turtle, map turtle, and midland painted turtle in Maumee Bay State Park.

No Federal endangered reptiles or amphibians are known to occur in the southwestern Lake Erie area. Spotted turtle is a state endangered reptile known to occur in the southwestern Lake Erie area. However, the Ohio Division of Natural Areas and Preserves has no record of spotted turtle having been found in the park. Spotted turtle inhabits marshy meadows, bogs, swamps, small ponds, and other shallow water bodies.

Birds

The entire southwestern Lake Erie area is well known for its diverse avifauna. The park is no exception and is in an area which experiences particularly high concentrations of birds in the spring and fall. This appears to be due to the fact that the park lies within the pathway of four migration routes. Two of the four routes are major continental routes - the Atlantic and Mississippi Flyways. Each passes over the western end of Lake Erie. The other routes are local routes. One route follows the Maumee River and then the Lake Erie shoreline. The other route follows the shoreline but crosses Maumee Bay at the Cedar Point spit.

The Ottawa National Wildlife Refuge staff has compiled a list of 267 birds identified within the refuge complex (Table 52 of USDI, FWS 1979). This list is representative of birds which may be found in the southwestern Lake Erie area including the park. Thirty-three species are year-round residents. Eighty-five species breed but do not winter in the area. The remaining one hundred and forty-nine species occur as migrants.

On April 19, May 3, June 25, and June 26, 1979, bird surveys were conducted by Fish and Wildlife Service biologists along Norden, Curtice, and Cousino Roads from Cedar Point Road to the Lake Erie shore. The birds were observed by sight or sound and recorded by observers. A list of birds observed is presented in Table 8. Ring-necked pheasants and various species of ducks and geese are known to utilize the area. The staff of the Ottawa National Wildlife Refuge have listed the old fields at the proposed park as one of the few remaining areas in Lucas County with good pheasant habitat. Flocks of mallards have been noted by State personnel in the fields immediately west of Norden Road. Mallard pairs are often seen alighting and flying from various locations in these fields. In studies by Earl (1950), Labisky (1957), and Milanski (1958), nesting on agricultural lands by mallards was documented. Thompson (1964) studied the use of hay and other agricultural fields by wildlife in the southwest Lake Erie region. Based on these observations and studies, nesting by mallards and pheasants can be expected to occur in the old field habitat that comprises the major part of the state park.

No colonial birds are known to nest in the area. Herons and egrets can be observed feeding along the ditches and in more secluded shallow water areas. Gulls and terns can be observed feeding over marshes and along the nearshore areas. Common tern is an Ohio endangered species which may be observed in the area.

Four pairs of bobolinks were observed within a small area of the proposed park approximately 50 feet from the Lake Erie shore and approximately 100-250 feet east of Norden Road. Bobolinks were also occasionally spotted in the park along Curtice Road. Bobolinks are found in open areas and nest in hayfields or in other dense, low ground cover. However, they are uncommon in the southwestern Lake Erie region as nesting birds. Declines in eastern populations have been attributed to nest disturbance from farming practices, lack of habitat, and competition with red-winged and Brewer's blackbirds (Harrison, 1975).

Northern harrier, short-eared owl, dickcissel, and grasshopper sparrow are locally threatened species in Ohio. Each of these species requires open habitats typical of marshes, prairies, meadows, fields, and dunes. Northern harrier and grasshopper sparrow are possible nesters within Maumee Bay State Park and vicinity. Short-eared owl has been noted to nest within the park. Dickcissel males have exhibited territorial behavior within the park.

The king rail is a state endangered bird reported to occur in the southwestern Lake Erie region. A preliminary field reconnaissance of the park failed to find sedge marsh edges with 4 to 18 inches of water which is the king rail's preferred nesting habitat. The occurrence of king rail in the park appears unlikely without the presence of suitable nesting habitat.

The upland sandpiper is a state endangered bird which occurs in Maumee Bay State Park. It is a possible nester within the park, preferring areas of low ground cover comprised primarily of grass.

The sharp-shinned hawk, an Ohio endangered species, also occurs in the area of proposed Maumee Bay State Park (Campbell, 1968). Preferred habitat consists of woodlands and thickets, with coniferous trees usually (but not exclusively) preferred for nesting.

The bald eagle is a Federal and State endangered species known to occur in the western Lake Erie region. Transient bald eagles are found along the Lake Erie shore during spring and fall migrations. A small resident population breeds in marginal habitat along the western Lake Erie shore. Habitat lost through shoreline development and human disturbances are major factors in the eagle's decline. While nests are generally located in the tops of tall trees within one mile of a major water body and fishery resource, no nests are known to have ever occurred within the park boundaries. In 1974, one inactive nest was located in Cedar Point NWR; however, no activity has been noted at this location since the nest blew down in 1975 (D. Case, pers. comm.).

Mammals

Forty-two species of mammals have ranges which fall within the study area (Table 70 of USDI, FWS, 1979). Any of these species could be expected to occur given the proper habitat. Common to the area are opossum, deer mouse, muskrat, cottontail, skunk, raccoon, red fox, and white-tailed deer.

The muskrat is a furbearer and can be found along ditches and cattail areas in the park. Their burrows are commonly dug into the banks. Utilization of the proposed park's marsh areas appears minimal due to the lack of water depth in cattail areas. However, a few muskrat houses were observed in October 1981 in a cattail area near the southern edge of the proposed nature area.

White-tailed deer are commonly seen in the fields in the early morning and late afternoon. However, Ottawa National Wildlife Refuge staff consider deer populations utilizing refuge areas along the lakeshore to be low. They have estimated the population using the refuge complex and surrounding areas to be approximately 30 individuals with approximately eight young produced each year (USDI, FWS, 1975 and 1976).

DISCUSSION

The project area and Maumee Bay State Park have fish and wildlife values in their existing undeveloped state. The large extent of old field vegetation at the proposed park is fairly uncommon in Lucas County due to the extensive and intense agricultural practices in the area. The presence of a very early successional vegetation stage has made it possible for uncommon species such as the bobolink to nest in the area and for pheasants to nest without risk of disturbance from mowing or other agricultural practices. The swamp-marsh area is particularly valuable to a wide range of wildlife species. Bird use and species diversity is especially noteworthy in this area of the park. Intermittent flooding of upland and inland areas by Lake Erie helps to maintain the early successional and swamp-marsh vegetation in the park. While the existing ecological situation is of value to fish and wildlife, eventually the upland and marsh habitats will erode away. Therefore, erosion protection will benefit wildlife species.

Nearshore currents and drift patterns in Lake Erie influence fish and aquatic movement, recruitment, and utilization of nearshore areas. However, a lack of information and understanding of nearshore currents, littoral drift, and erosion processes at the project site have made it difficult to assess the impacts of the proposed plans. There is little information on nearshore current patterns, and there appears to be conflicting views on littoral drift. M&N's estimate of the littoral transport potential at the project site appears to conflict with Benson's (1978) assessment that there is no new littoral drift.

There will be some adverse impacts as a result of construction in all structural alternatives. Increased turbidity, compaction of substrate, and some disturbance of vegetation may be unavoidable during shore protecion

and temporary road construction. Measures should be implemented to mitigate these adverse impacts.

The dominance of silt, mud, and clay bottom types throughout the Maumee Bay area explains the dominance of rough fish in Maumee Bay as Herdendorf and Cooper (1975) noted. In comparison, the nearshore zone of Maumee Bay offers a more diverse array of fish habitats because of habitats created by wetlands, shore protection structures, and beaches. However, such habitat types along the shore of Maumee Bay are limited. The value of the nearshore zone to the fisheries resource is significant and is well documented.

Based on existing information and the predominance of a shallow silt, mud, and clay bottom at the project site, long term impacts to the fisheries resource along the nearshore zone of Maumee Bay State Park appear to be minimal. The replacement of loam substrate with sand, stone, or rubble should not result in any significant loss of fisheries utilization in the area if other environmental factors are favorable. However, the offshore breakwaters may increase offshore erosion. An increase in offshore erosion would alter fish habitat by increasing depth and by exposing different layers of bottom sediments. The gap in the rubble revetment to be provided for fish access and for the maintenance of flow from drainage ditches to the lake should also help maintain the interdependent relationship between the marsh and lake.

The sandy shoal which comprises the Cedar Point spit is unique in its combination of characteristics. Similar to the nearshore zone, the spit constitutes habitat of a very shallow nature. However, unlike the nearshore zone, the spit extends for a great distance from the shore to Turtle Island. Sand, which is a limited resource of Lake Erie, is available in various grades and quality within the spit. Similar to a more riverine environment, the spit is constantly swept by a southerly current as well as by wind generated wave action across the lake. The existence of currents along and across the spit is important because it suggests that fish which either need clean substrate or current for the development of their eggs may find suitable habitat at the spit. Core samples by Herdendorf and Cooper (1975) confirm that areas of clean sand and gravel do exist at various places on or around the spit.

An attempt was made to gain information on the Cedar Point spit area by various fish species based on existing information and past studies. The use of past studies to gain this information has some severe limitations. Aside from Fraleigh's et al., (1975) work and a few common or abundant fish species, lists of fish expected to occur at Maumee Bay have not been verified by captures in the field. Species are often missed if sampling is conducted only during daylight hours or if sampled too infrequently. The best single fisheries study to provide information on fish spawning at the Cedar Point spit comes from Mizera (1981). While Mizera's study sheds some light on spawning in the area, it is not indicative of uses of the spit for purposes other than spawning, i.e., feeding or at other seasons.

Existing information offers fairly conclusive evidence that the spit is used for spawning by gizzard shad, alewife, white bass, yellow perch,

emerald shiner, sauger, walleye, spottail shiner, trout-perch, and freshwater drum. However, it is not possible to deduce from existing information the extent of contribution of the spit to recruitment of fish to their respective populations in Lake Erie. It appears possible that species such as smelt, Johnny darter, sand shiner, white sucker, white perch, whitefish, and channel darter also utilize the spit (Table 4). Additional sampling would be necessary to more fully document the utilization of the Cedar Point spit by fish species.

The presence of mooneye, an Ohio endangered species, in Maumee Bay has been documented by Herdendorf and Cooper. The life history of mooneye in Lake Erie is not well known. While no specimen of mooneye has been taken at the Cedar Point spit, the finding of larvae close to a site where core sampling revealed a surface layer of coarse-grained sand seems to suggest that mooneye may spawn in sandy areas.

The dredging of the Cedar Point spit will result in increased turbidity, entrainment of ichthyoplankton, and alteration or loss of fisheries habitat. The dredging of sand from the Cedar Point spit may also increase erosion 1,000 to 2,000 feet offshore of the project area (Herdendorf and Cooper, 1975). Sand and gravel removed from the Cedar Point spit will not be significantly replaced. Longshore currents deposit only small amounts of sand. Shallow areas of clean sand on the Cedar Point spit are part of a very limited Lake Erie resource. Such areas may be severely and irreversibly altered by dredging should depressions caused by dredging refill with silts, muds, and clays rather than with sand. The dredging of the Cedar Point spit will involve a irreversible and irretreivable commitment of resources (Herdendorf and Cooper, 1975).

Alternatives to obtaining sand from Cedar Point spit include: (1) finding an alternate Lake Erie source, (2) trucking sand in from an upland source or from an existing sand and gravel operation, and (3) utilizing multiple sand sources. Obtaining sand from a lake source would still have impacts associated with turbidity, entrainment of ichthyoplankton, and alteration or loss of habitat. However, if the fisheries resource at an alternate site was discovered through field studies to be less diverse and/or less productive than the Cedar Point spit area, the overall impact to fisheries would be minimized assuming other factors, such as type of equipment used and size and depth of area to be affected, remain the same. Obtaining sand from an upland source or active sand and gravel operation would have the least offsite impacts. This alternative would be preferable from a fisheries standpoint. Due to the quantities of sand needed for the initial construction of the beach, a feasible alternative may be the utilization of multiple sand sources. This alternative may be effective in minimizing impacts to the fisheries resource and in minimizing depletion of a sand resource at any one site. Due to the vast quantity of sand needed for initial construction of a beach, this alternative should be given some consideration. However, more detailed study of this alternative would be needed to develop the guidelines, limitations, and recommendations necessary to minimize the aforementioned impacts.

At present, ODNR proposes to develop the swamp-marsh area located in the northeastern quadrant of the proposed park as a natural area. The

swamp-marsh area which lies adjacent to Cedar Point NWR will help to serve as a buffer zone for the refuge. While ODNR's plan will result in the preservation of one or two major wetland habitat types, other construction plans may displace or change the vegetational composition of the remaining area. Construction of a golf course will replace substantial areas of old field with mowed grass. Mowed grass has little habitat value to all but a few wildlife species, such as thirteen-lined ground squirrel and a few ground feeding birds. The vegetational change may result in decreased nesting by pheasants, bobolinks, and mallards. Also it may decrease utilization of the area by marsh hawks and other raptors. The proposed location for the parks's lodge and cabin complex may impact an area of snags noted to be a particularly active bird site.

In order to maintain floral and faunal diversity and to minimize adverse effects to wildlife in the area, a recommendation was made that ODNR consider the preservation and maintenance of certain types of habitat, opportunities to increase the wildlife diversity or carrying capacity of available areas, and management techniques which would be compatible to both wildlife and public uses. ODNR has recently implemented the recommendation and has designated 125 acres within Maumee Bay State Park to be managed as a meadow area. The meadow-management area will benefit short-eared owls, other raptors, various migrating, transient, and nesting species of birds, and other wildlife.

SUMMARY AND RECOMMENDATIONS

The U. S. Fish and Wildlife Service has no objection to the proposed shore protection at Maumee Bay State Park. Based on existing information, the U.S. Fish and Wildlife Service has found Alternatives 2, 3, and 5 acceptable as presently designed. Nearshore currents and drift patterns influence fish and aquatic movement, recruitment, and utilization of nearshore areas. Alternative 2 has the distinct advantage of being the least disruptive to existing current and drift patterns provided an upland sand source is used. Alternative 3 would be more disruptive to existing currents. Alternative 5 may contribute to offshore erosion. In Alternatives 3 and 5, structures would diversify fisheries habitat in the area if constructed of large stone or riprap. Alternative 4 would cause the greatest disruption of existing current and drift patterns. Additional site-specific information on littoral transport and nearshore current patterns will be needed before further consideration can be given to this alternative.

The following recommendations are offered for consideration in future project planning and development. These recommendations have been made in the interest of mitigating adverse impacts to fish and wildlife resources. Subsequent park development can be considered a secondary impact of the proposed project. Therefore, in addition to recommendations to the Corps, suggestions on the mitigation of impacts to fish and wildlife resources have been included for ODNR's consideration with park development plans.

Recommendations to the Corps of Engineers:

1. Obtaining sand from an upland source or from an active sand and gravel operation will have the least impacts and is therefore preferable to impacting a Lake Erie fisheries resource through dredging for a lake source of sand.

2. Alternative sand sources should continue to be investigated and assessed.

3. If obtaining a lake source of sand is to be pursued, an ichthyoplankton survey to be conducted at night during the spawning season is recommended to gather site specific baseline data for the assessment of impacts and for the development of guidelines, limitations, and recommendations to mitigate adverse impacts. Ideally, such a survey should include the study of two lake sand source sites. The study should be contracted by either the Army Corps of Engineers or the sand contractor and completed prior to issuance of any Army Corps of Engineers permit to dredge any proposed area in Lake Erie unless part of an active sand and gravel operation.

4. Additional consideration should be given to:

   (a) the quality and quantity of sand available at any particular site,

   (b) whether or not dredging will deplete the sand resource and preclude the future availability of sand from a particular site,

   (c) problems regarding the enforcement of permit restrictions, if any, for a dredging operation of this type,

   (d) commitment of lake sand resources to future exploitation, and

   (e) cumulative effects of lake sand and gravel dredging on the Lake Erie ecology and littoral drift systems.

5. The use of sheet pile or concrete walls as shore protection structures should be avoided. The use of materials such as large rock riprap will provide fisheries benefits and is preferable.

6. Impacts to existing resources would be minimal with Alternative 5, and with Alternative 2 provided an upland sand source is obtained. In Alternative 5, the total revetment has potential to diversify aquatic habitat benefitting local fisheries. However, due to the extreme shallowness of the water, the benefit would be minimal if riprap is placed along the shore and did not extend into the water to a depth of at least three feet. Alternative 5 will contribute to some offshore erosion. Alternative 2 would replace some of the offshore silt-mud-sand habitat with sand. Since sand is a limited resource in Lake Erie, the substitution of an abundant habitat type for one with limited availability would not be detrimental to the fisheries. Because of its potential to diversify the offshore habitat and minimal disruption of existing resources, Alternative 2 with an upland sand

source has been identified as the Service's preferred alternative. Alternatives 3a or 3b are acceptable provided breakwater structures are constructed of large rock riprap as presently planned.

7. Need for a temporary haul or construction road should be eliminated by use of the top of the revetment for construction and delivery of material to the construction site. This would eliminate impacts associated with constructing and removing a temporary road. Where temporary roads are needed in wetland areas, fill material used in their construction should be made of clean, non-erodable material. A filter bed made of inert material should be placed beneath fill material used in construction of the temporary road in marsh and/or water saturated areas. The filter bed should help minimize compaction and maximize the recovery of fill material when the temporary road is removed in its entirety. In upland areas, temporary roads should be seeded and mulched as soon as possible when no longer needed.

8. Disruption of vegetation, particularly in the swamp-marsh and proposed nature areas, should be avoided or minimized. The wildlife or rubble revetment should be placed as lakeward as possible to minimize impacts to existing upland habitat and nearshore marsh areas.

9. The 100-foot gaps in the wildlife revetment should be located to optimize fish access to the most promising spawning location along the Maumee Bay State Park shoreline. In a letter dated May 25, 1982, Ohio Department of Natural Resources identified the wetland habitat at the far east shore near Anderson Ditch as an area that may be particularly valuable to certain fish species or life stages of fish species. The U. S. Fish and Wildlife Service concurs with this opinion. Final site plans for the location of the 100-foot gap should be coordinated with the U. S. Fish and Wildlife Service, Ohio Division of Wildlife, and other interested parties.

10. The placement of large culverts in the wildlife revetment may be needed to improve water circulation in some areas and should be considered.

11. The 100-foot gap can be expected to be an area of notable scouring as water level changes result in an influx and outflow of great quantities of water through this point. To reduce excessive erosion and failure of the revetment at the gap, the ends of the gap should be toed in to the depth necessary and constructed of heavy riprap to stabilize properly the ends of the gap and turn-around area.

12. The proposed storm dune behind the beach should be vegetated to stabilize the dune, to prevent loss of sand to inland areas, and to provide a travel lane for wildlife.

13. Erosion control measures should be employed as needed.

Suggestions to Ohio Department of Natural Resources:

1. The State may find a completed biological inventory of rare and unusual plants and wildlife helpful in the planning and determination of park management goals.

2. Habitats may be designated and managed for certain field species, such as bobolink and pheasant. Such areas may be designated with minimal or no inconvenience to the public along peripheries of campgrounds, golf course, and marsh areas. Pheasant nesting has been found compatible with rights-of-way along roads and highways. The U. S. Fish and Wildlife Service commends Ohio Division of Parks and Recreation in their recent decision to establish a 125-acre meadow management area.

3. Mowing can be scheduled such that adverse impacts to wildlife are minimal. By delaying mowing to mid-July, impacts on the rearing success of nesting pheasants, rabbits, and other ground and low cover species will be minimal.

4. It would be desirable if the area of snag trees located in the southeastern portion of the nature area could be preserved. Snag trees have favorable cavity forming characteristics and are a scarce resource. They are important to hole nesting birds such as wood ducks, owls, woodpeckers, chickadees, titmice, and nuthatches. They also provide perching sites for raptors. The location of the lodge and some of the cabins as presently planned may impact this area.

5. Ditch banks should be vegetated to provide food, cover, and a travel corridor for wildlife species.

6. Borrow pits could be modified or constructed as wetlands to provide valuable wildlife habitat. The creation of islands and shallow water areas, the use of selective plantings such as reed canary grass around the pit's perimeter, and the provision of adequate water deep enough for the survival of fish are a few of the measures which could be employed to increase the value of borrow pits to fish and wildlife resources.

There is no designated critical habitat in the project area at this time.

In accordance with Section 7(c) of the Endangered Species Act of 1973, as amended, the Federal agency responsible for actions authorized, funded, or carried out in furtherance of a construction project that significantly affects the quality of the human environment, is required to conduct a biological assessment. The purpose of the assessment is to identify listed or proposed species likely to be adversely affected by their action and to assist the Federal agency in making a decision as to whether they should initiate consultation.

The biological assessment is to be completed within 180 days of initiation and before contracts are entered into or construction begins.

Attached is a list of the Federal agencies' major responsibilities regarding endangered species.

The above endangered species comments provide informal consultation only and do not fulfill the requirements of Section 7 of the Endangered Species Act as amended.

Sincerely yours,

James C. Gritman

James C. Gritman
Acting Regional Director

Attachments

cc: ODNR, Division of Wildlife, Columbus, OH
ODNR, Outdoor Recreation Service, Attn: M. Colvin, Columbus, OH
ODNR, Division of Parks and Recreation, Columbus, OH (2)
U.S.EPA, Office of Environmental Review, Chicago, IL
Ohio EPA, Columbus, OH Attn: J. Albrecht

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Table 1. Quantities of sand and gravel material removed from designated dredging Areas A, B, & C of the Cedar Point spit between 1960 and 1981*

	Quantity	
Year	Cubic Yards	Tons (= 1.6 ton/yd^3)
1958	62,463	99,941
1959	61,833	98,933
1960	34,156	54,650
1961	68,527	109,643
1962	118,984	190,374
1963	102,015	163,224
1964	61,954	99,126
1965	3,869	6,190
1966	17,978	28,765
1967-73	no production	
1974	9,332	14,931
1975	4,366	6,986
1976	1,600	2,560
1977	7,600	12,160
1978	2,116	3,386
1979	2,896	4,634
1980-81	no production	
Total	559,689	895,503

* From H. Collins (1981) Pers. comm.
Ohio Department of Natural Resources, Div. Geological Survey
Columbus, Ohio.

Table 2. Wetland acreages of Maumee Bay State Park (MBSP)*

Wetland Description**	Area (acres)
Proposed wetland nature area	
$P\frac{FO}{SS}1Y$	96.0
$P\frac{SS1}{EM}Y$	53.0
Wetlands to be impacted by proposed golf course	
$P\frac{FO}{SS}1Y$	17.0
PFO1Y	12.5
PEMYh	3.0
Wetlands not addressed by MBSP Master Plan	
PEMY	38.0
PEMYh	24.5
Total	244.0

* Based on USDI, FWS, April 1977, National Wetlands Inventory maps.

** Refer to Key on Figure 4 or Cowardin, et al. (1979).

Table 3. Fish species expected to occur in nearshore and offshore areas of Maumee Bay

Species	Reference Source 1	2	3	4
Lake sturgeon *Acipenser fulvescens*		x		x
Spotted gar* *Lepisosteus oculatus*		x		x
Longnose gar *Lepisosteus osseus*		x		x
Bowfin *Amia calva*				x
American eel *Anguilla rostrata*		x		
Alewife *Alosa pseudoharengus*	x			x
Gizzard shad *Dorosoma cepedianum*	x	x	x	x
Mooneye* *Hiodon tergisus*	x	x		
Lake whitefish *Coregonus clupeaformis*		x	x	x
Chinook salmon *Oncorhynchus tshawytscha*				x
Rainbow trout *Salmo gairdneri*	x			x
Brown trout *Salmo trutta*				x
Rainbow smelt *Osmerus mordax*				x
Northern pike *Esox lucius*	x	x	x	
Muskellunge* *Exox masquinongy*		x	x	
Goldfish *Carassius auratus*	x	x	x	x
Common carp *Cyprinus carpio*	x	x	x	x
Silver chub* *Hybopsis storeriana*		x		x
Golden shiner *Notemigonus crysoleucas*		x		
Emerald shiner *Notropis atherinoides*		x		x

Table 3. (continued) Fish species expected to occur in nearshore and offshore areas of Maumee Bay

	Reference Source 1	2	3	4
Spottail shiner *Notropis hudsonius*		x		x
Spotfin shiner *Notropis spilopterus*		x		x
Sand shiner *Notropis stramineus*		x		x
Redfin shiner *Notropis umbratilis*		x		
Mimic shiner *Notropis volucellus*				x
Bluntnose minnow *Pimephales notatus*		x		x
Fathead minnow *Pimephales promelas*				x
Quillback *Carpiodes cyprinus*	x		x	x
White sucker *Catostomus commersoni*	x	x	x	x
Bigmouth buffalo *Ictiobus cyprinellus*		x	x	x
Silver redhorse *Moxostoma anisurum*		x	x	x
Golden redhorse *Moxostoma erythrurum*			x	x
Shorthead redhorse *Moxostoma macrolepidotum*		x	x	x
Greater redhorse* *Moxostoma valenciennesi*		x	x	
Black bullhead *Ictalurus melas*		x		x
Yellow bullhead *Ictalurus natalis*				x
Brown bullhead *Ictalurus nebulosus*		x	x	x
Channel catfish *Ictalurus punctatus*	x	x	x	x
Stonecat *Norturus flavus*		x		x
Brindled madtom *Noturus miurus*				x

Table 3. (continued) Fish species expected to occur in nearshore and offshore areas of Maumee Bay

	Reference Source			
	1	2	3	4
Trout-perch *Percopsis omiscomaycus*		x		x
Burbot* *Lota lota*		x		x
Brook silverside *Labidesthes sicculus*		x		x
White perch *Morone americana*				x
White bass *Morone chrysops*	x	x	x	x
Green sunfish *Lepomis cyanellus*		x		x
Pumpkinseed *Lepomis gibbosus*		x		x
Bluegill *Lepomis macrochirus*		x		x
Smallmouth bass *Micropterus dolomieui*		x		x
Largemouth bass *Micropterus salmoides*		x		x
White crappie *Pomoxis annularis*		x	x	x
Black crappie *Pomoxis nigromaculatus*		x	x	
Eastern sand darter* *Ammocrypta pellucida*				x
Iowa darter* *Etheostoma exile*				x
Johnny darter *Etheostoma nigrum*		x		x
Yellow perch *Perca flavescens*	x	x	x	x
Logperch *Percina caprodes*		x		x
Channel darter* *Percina copelandi*		x		x
Sauger *Stizostedion canadense*		x	x	x
Walleye *Stizostedion vitreum*	x	x	x	x

Table 3. (continued) Fish species expected to occur in nearshore and offshore areas of Maumee Bay

	Reference Source			
	1	2	3	4
Freshwater drum *Aplodinotus grunniens*	x	x	x	x
Mottled sculpin *Cottus bairdi*				x

* Classified as Ohio endangered species

Reference Sources:

1 Fish species expected to occur in Maumee Bay during spring; from Fraleigh *et al.* (1975) based on Scott and Crossman (1973).

2 Fish inhabiting Maumee Bay prior to 1957; from Pinsak and Meyer (1976) based on Trautman (1957).

3 Fish believed to presently inhabit Maumee Bay; from Pinsak and Meyer (1976).

4 Fish expected to utilize unvegetated sandy mud, gravel and silt areas in Maumee Bay; from Hartley and Van Vooren (1977).

Table 4. Fish caught in Maumee Bay by various researchers since 1975.

	Larger Fish Studies			Ichthyoplankton Studies			
Reference Source:	1	2	3	4	5	6	7
Alewife *Alosa pseudoharengus*	x	x		x	x		
Gizzard shad *Dorosoma cepedianum*	x	x	x	x	x	x	x
Mooneye* *Hiodon tergisus*				x			
Lake whitefish *Coregonus clupeaformis*						x	
Rainbow trout *Salmo gairdneri*	x						
Rainbow smelt *Osmerus mordax*		x		x	x	x	x
Northern pike *Esox lucius*	x						
Goldfish *Carassius auratus*	x	x					
Common carp *Cyprinus carpio*	x	x	x	x	x	x	x
Silver chub* *Hybopsis storeriana*		x					
Emerald shiner *Notropis atherinoides*		x	x	x	x	x	x
Spottail shiner *Notropis hudsonius*		x	x	x	x	x	x
Unidentified Cyprinidae spp.						x	x
Quillback *Carpiodes cyprinus*						x	x
White sucker *Catostomus commersoni*	x	x		x	x	x	
Shorthead redhorse *Moxostoma macrolepidotum*		x					
Black bullhead *Ictalurus melas*		x					
Yellow bullhead *Ictalurus natalis*			x				
Channel catfish *Ictalurus punctatus*	x	x				x	x
White bass *Morone chrysops*	x	x	x	x	x	x	x

Table 5. Relative abundance of larval fishes captured in western Lake Erie in 1977*

Species	Michigan Shoreline Stoney Point to Woodtick Peninsula		Maumee Bay		Ohio Shoreline Little Cedar Point to Locust Point	
	Average Density**	Percent of Catch	Average Density	Percent of Catch	Average Density	Percent of Catch
Gizzard shad	193.82	75.00	541.80	90.58	183.26	81.27
Emerald shiner	31.98	12.38	5.57	0.93	6.97	3.07
Yellow perch	21.07	8.15	17.84	2.98	24.19	10.65
Common carp	4.77	1.85	1.22	0.21	0.85	0.37
White bass	3.02	1.17	23.32	3.99	4.50	1.99
Logperch	2.00	0.76	0.74	0.12	1.04	0.45
Rainbow smelt	0.63	0.24	2.00	0.34	0.54	0.24
Freshwater drum	0.50	0.19	5.07	0.85	1.35	0.60
Walleye	0.21	0.08	0.30	0.05	2.72	1.18
Spottail shiner	0.12	0.04	0.16	0.03	0.25	0.11
Unidentified sunfish (*Lepomis* spp.)	0.11	0.04	0.01	0.01		
Lake whitefish	0.09	0.04			0.05	0.02
Unidentified (Cyprinidae spp.)	0.06	0.02	0.02	0.01		
White sucker	0.01	0.01				
Trout perch	0.01	0.01	0.01	0.01	0.01	0.01
Channel catfish	0.01	0.01	0.01	0.01	0.01	0.01
Unidentified crappie (*Pomoxis* spp.)	0.01	0.01			0.02	0.01
Sauger			0.05	0.01		
Quillback			0.02	0.01	0.01	0.01
Unidentified (Perceidae spp.)			0.01	0.01		
Unidentified			0.05	0.01		
Total	258.42		598.18		231.20	

* From Tables 5, 6, and 7 of Mizera (1981).

** Average density found by dividing sum of the calculated densities by the number of tows taken during period of larval occurrence.

Table 6. Lake Erie fish species which have a critical need for exposed sand and/or gravel habitat at some time during their lifespan*

	Sand/gravel Habitat Requirements		
	Spawning	Nursery	Feeding
Alewife *Alosa pseudoharengus*	x	x	x
Gizzard shad *Dorosoma cepedianum*	x		
Lake whitefish *Coregonus clupeaformis*	x		
Rainbow smelt *Osmerus mordax*	x	x	
Spottail shiner *Notropis hudsonius*	x		
Spotfin shiner *Notropis spilopterus*			x
Sand shiner *Notropis stramineus*	x	x	x
Trout-perch *Percopsis omiscomaycus*	x		
White perch *Morone americana*	x	x	x
White bass *Morone chrysops*	x		
Eastern sand darter** *Ammocrypta pellucida*	x	x	x
Johnny darter *Etheostoma nigrum*		x	x
Logperch *Percina caprodes*	x	x	x
Channel darter** *Percina copelandi*	x		
Sauger *Stizostedion canadense*		x	
Walleye *Stizostedion vitreum*	x	x	

* Modified from Hartley and Van Vooren, 1977.

** Classified as Ohio endangered species.

Table 7. Occurrence and physical parameters associated with larval mooneye (Hiodon tergisus) off Little Cedar Point, Lake Erie on 5/24/75*

Location:	North of Buoy 38	
Latitude	41°43'70"	
Longitude	83°25'70"	
Time of Sampling:		1225
Mooneye larval density		
Surface		0.00 Larvae/100 m^3
Bottom		7.94 Larvae/100 m^3
Water depth		3.0 m
Transparency		0.1 m
Temperature		
Surface	21.8°C	
Bottom	20.8°C	
Dissolved oxygen		
Surface	6.3 mg/l	
Bottom	5.6 mg/l	
Conductivity		
Surface	480 umhos/1	
Bottom	480 umhos/1	

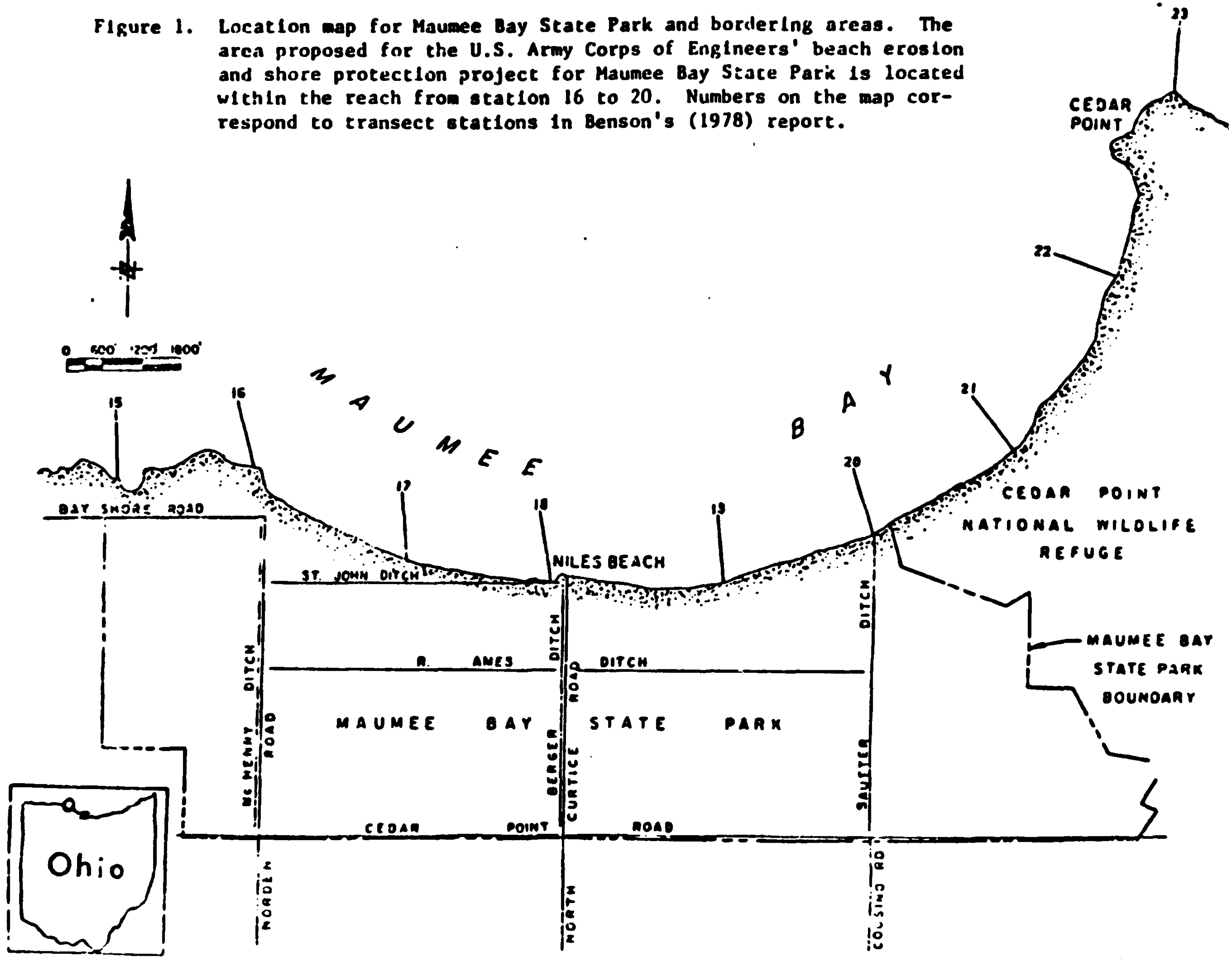
Sediment and core description[1]

0-1.5 ft	Sand -- 1" coarse grained on top; lower ½ sand -- fine grained; silt
2.6 ft	Sand and gravel, upper surface
4.3 ft.	Sand -- coarse grained; gravel up to 3/4" diameter

* From Tables 1, 13, 25, and 30 of Herdendorf and Cooper (1975).

1 Sediment and core samples were taken on 6/5/68 at Latitude 41°43'70" longitude 83°25'80"

Figure 1. Location map for Maumee Bay State Park and bordering areas. The area proposed for the U.S. Army Corps of Engineers' beach erosion and shore protection project for Maumee Bay State Park is located within the reach from station 16 to 20. Numbers on the map correspond to transect stations in Benson's (1978) report.



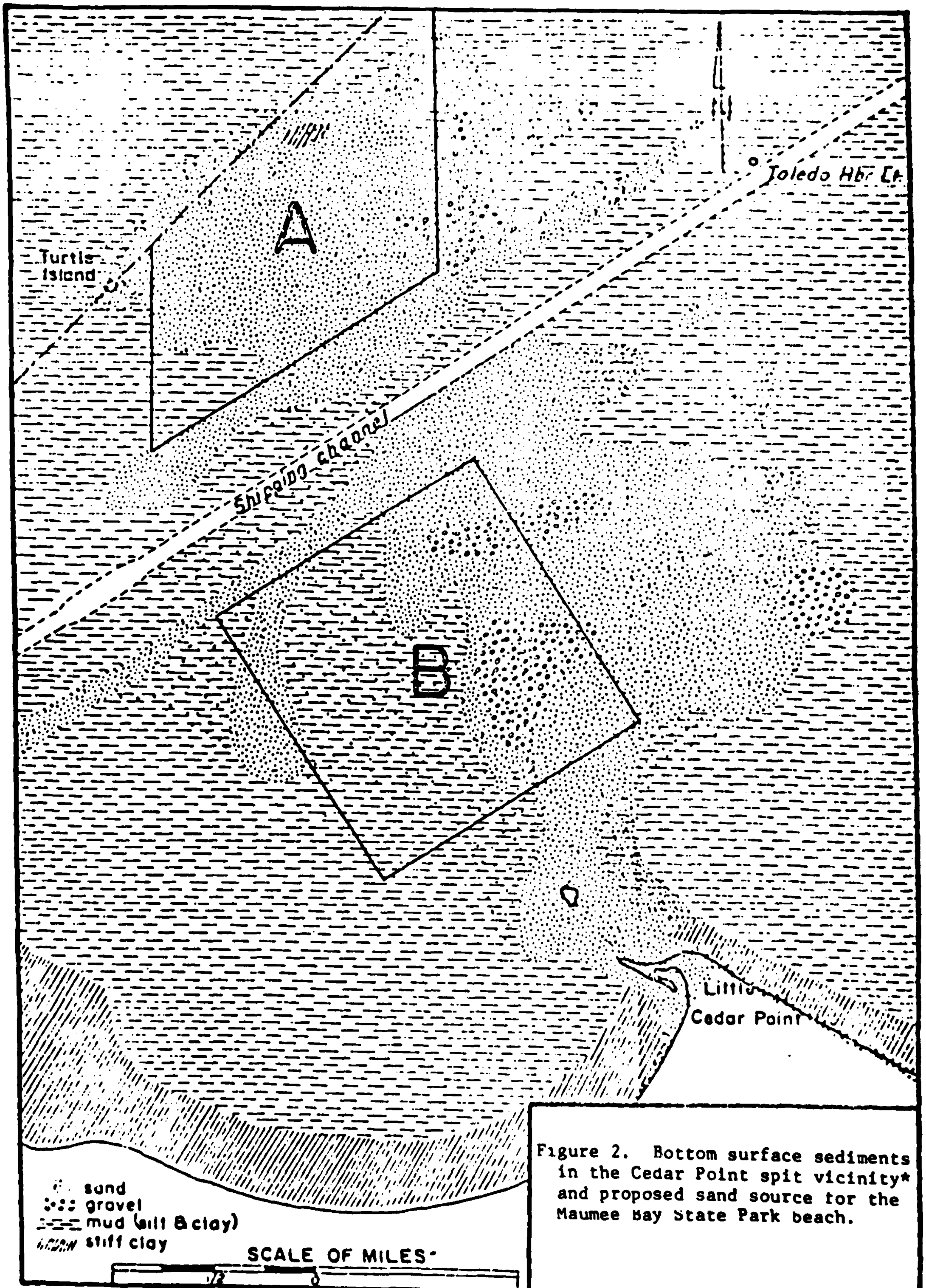


Figure 2. Bottom surface sediments in the Cedar Point spit vicinity* and proposed sand source for the Maumee Bay State Park beach.

* From Hartley (1960).

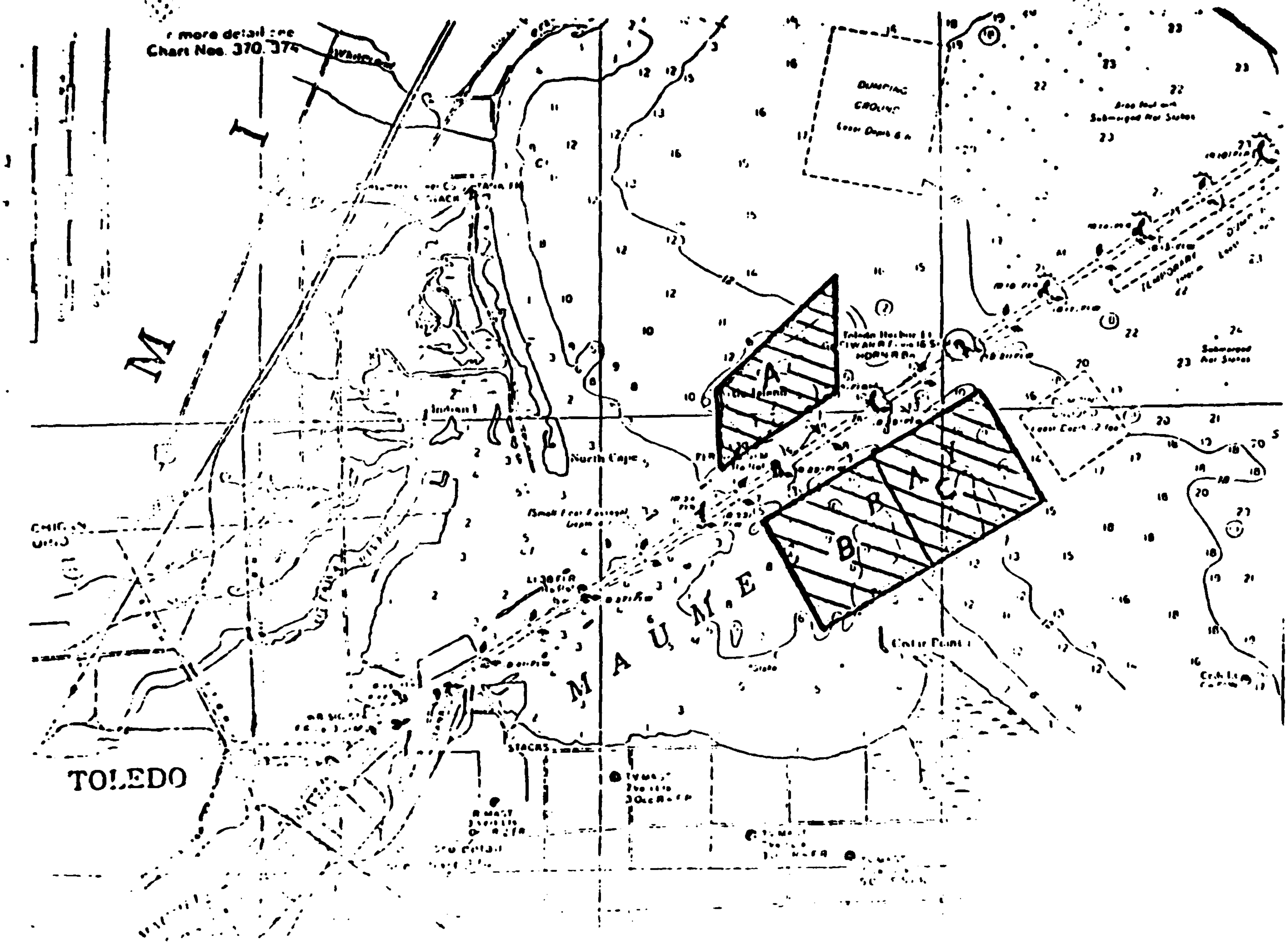


Figure 3: Areas permitted by the Army Corps of Engineers to White Brothers Sand and Gravel for dredging between 1977 and 1980.

ODNR

Ohio Department of Natural Resources

DIVISION OF WILDLIFE

Fountain Square · Columbus, Ohio 43224

July 30, 1982

Mr. Kent E. Kroonemeyer, Supervisor
Columbus Field Office
U.S. Fish & Wildlife Service
3990 East Broad St.
Columbus, OH 43215

Dear Kent:

We have reviewed the Final Fish and Wildlife Coordination Act Report for the Maumee Bay State Park, shoreline erosion project and concur with the summary and recommendations contained therein.

As we stated in our December 1981 letter, we believe that implementation of the recommendations to the ODNR will serve to protect and enhance wildlife habitat within the park.

We appreciate the opportunity to review your report and to provide these comments.

Sincerely,

STEVEN H. COLE
Chief

SHC:bb

cc: D. Olson, Chief, Division Parks & Recreation
R. Hubbell, Chief, Office Outdoor Recreation Services
J. Swartzmiller, Chief Engineer

ODNR

Ohio Department of Natural Resources

DIVISION OF PARKS & RECREATION
Fountain Square · Columbus Ohio 43224

August 6, 1982

Mr. Kent Kroonemeyer, Supervisor
Columbus Field Office
U.S. Fish & Wildlife Service
3990 East Broad Street
Columbus, Ohio 43215

Dear Mr. Kroonemeyer:

We have reviewed the Final Fish and Wildlife Coordination Act Report for the Maumee Bay State Park shoreline erosion project. The summary and recommendations meet with our approval.

Please furnish a copy of the final report to Jim Brower, Park Manager, Maumee Bay State Park, for his files.

Thank you for your cooperation.

Sincerely,

Larry K. Henry

Donald G. Olson
Chief

DGO/blp

JAMES A RHODES Governor • ROBERT W TEATER Director • DONALD G OLSON Chief

ODNR

Ohio Department of Natural Resources

DIVISION OF NATURAL AREAS & PRESERVES

Fountain Square • Columbus, Ohio 43224 • (614) 265-6472

July 30, 1982

Ms. Diana Wong
U.S. Fish and Wildlife Service
3990 E. Broad Street
Columbus, Ohio 43215

Dear Ms. Wong:

A copy of the Maumee Bay State Park information sent to the U.S. Army Corps of Engineers on May 19, 1981 is attached. The state plant law, administrative rules, and current list of Ohio endangered and threatened plant taxa are also included.

Since my correspondence with the Corps of Engineers, we have obtained a record for one rare plant species at Maumee Bay:

Potentilla anserina - Silverweed, potentially threatened (not a legal designation)

Please contact me at the letterhead number if you have any questions about the enclosed materials.

Sincerely,

Patricia D. Jones

Patricia D. Jones
Ecological Analyst

PDJ/sl

Enclosures

APPENDIX H
CULTURAL RESOURCES

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

Archeological Testing and Evaluation of Site 33-Lu-247, Maumee Bay State Park Lucas County, Ohio

Prepared for

Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14217

by

Robert F. Hoffman
and Thomas L. Struthers
John Milner Associates, Inc.
309 North Matlack Street
West Chester, PA 19380

1981

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ABSTRACT

The Maumee Bay Site, 33-Lu-247, was initially identified and recorded by Pratt in 1979. John Milner Associates, under contract to the Buffalo District, Corps of Engineers, conducted a program of intensive testing and evaluation of the site in order to allow determination of its National Register eligibility and assessment of effects expected to accompany proposed erosion control measures and State Park developments. Work undertaken included informant interviews, literature review, and surface and subsurface testing of both fast land and submerged portions of the site. Two distinct loci of prehistoric activity were identified, but were found to contain mixed deposits lacking contextual integrity. The site is not believed to be applicable to current or anticipated research questions and is not considered eligible for the National Register. Accordingly, the proposed project is expected to have no effect upon significant cultural resources. No further investigation of the Maumee Bay site is recommended.

ACKNOWLEDGMENTS

The following individuals all deserve thanks for their efforts which facilitated the successful completion of this survey.

Mr. Bruce I. Sanders	Corps of Engineers, Buffalo District
Mr. Roderick R. Madore	Corps of Engineers, Buffalo District
Mr. James Bower	Supervisor, Maumee Bay State Park
Dr. G. Michael Pratt	Regional Archeologist, O.H.P.O.
Dr. David M. Stothers	Assoc. Professor, University of Toledo
Mr. Eugene Paulsen	Avocational Archeologist, Genoa, Ohio
Mr. Frank Schmidt	Avocational Archeologist, Oregon, Ohio

Special thanks are due to G. Michael Pratt, Regional Archeologist for the Ohio Historic Preservation Office, who was instrumental in the successful completion of this project. He took the time to visit the site, provided the field crew with the names of local informants, and provided information on the site and on Ohio archeology as it relates to the Maumee Bay site. Dr. Pratt also helped to compile a body of references and publications useful in the completion of this project report. His continued guidance, advice, and professional expertise concerning the local archeology was as much an asset to the survey as was his geniality to the morale of the field team.

John Milner Associates personnel who participated in the project include the following: Daniel G. Roberts, Principal Investigator, authored the Professional Services Proposal and provided assistance in both administration and archeological matters; fieldwork and artifact processing were performed by Robert F. Hoffman and Kenneth M. Joire; Hoffman and Thomas L. Struthers prepared the text of the Final Report; and Sarajane Ruch produced the graphics. Pamela McAlonan typed the manuscript and attended to other production details.

I. INTRODUCTION

Project Location

The Maumee Bay Site, 33-Lu-247, is located in Maumee Bay State Park, five miles due east of the city limits of Toledo, in Lucas County, northwestern Ohio (Figure 1). The site is located on the Reno Beach quadrangle, U.S.G.S. 7.5' series, at U.T.M. reference points:

The park area covers two square miles of land on the southern shore of Maumee Bay at the extreme western end of Lake Erie. The project area is bounded on the west by North Curtice Road, to the south by Cedar Point Road, to the east by Cedar Point National Wildlife Refuge and to the north by the lake. The site proper extends from a point 1,300 feet east of North Curtice Road to a point 2,600 feet east of the road, along the shore of Maumee Bay.

General Description

The park area is presently composed of formerly cultivated lands, forests, and several beach areas (Figure 2). The area immediately west of the project area contains offices and maintenance facilities for park employees as well as two large camping areas. The park serves as a wildlife refuge and a recreation area for campers and boaters. Future plans for development of the park include additional camping areas, rental cabins, a golf course, and a nature walk which is to consist of boardwalks built through the poorly drained woods and swamp south of and adjacent to the Maumee Bay site.

The site is located on two different soil types listed in the Lucas County soil survey as latty silty clay (Lc) and Toledo silty loam (To) (Stone, *et al.* 1980). Both are very poorly drained, deep and nearly level and provide excellent habitats for wetlands wildlife. These soil types are suitable for crops only when artificially drained, as they are either wet or submerged for most of the year.

The site proper is composed of a stretch of narrow sandy beach ten to twenty-five feet wide, south of which are poorly drained woods with twelve to eighteen inches of standing water. All the trees are either dead or dying and the area is being infested by phragmites and cattails. The entire length of shoreline is jammed with dead trees and debris brought in by storms, making access by land difficult. A similar situation exists in the poorly drained woods south of the site, although it is compounded by fallen trees and thick marsh grasses encroaching upon the woods. The beach is only visible when the winds are out of the southwest. The southwestern winds tend to push the water to the eastern end of Lake Erie, thereby exposing up to 300 feet of mud flats north of the site.

To the west of the site proper, from zero to 1,300 feet east of North Curtice Road, the shoreline is revetted with chunks of concrete. This revetment is composed of the remains of 20 or 30 beach cottages severely damaged by Hurricane Agnes in 1972 and removed by the state when the land was acquired for the park. A dirt lane extends eastward from North Curtice Road and trends parallel to the

the shore some 200 feet south of it. The land to the south of the road is composed of relatively well-drained cropland which has lain fallow since it was acquired by the state. To the east of the site proper, from a point 2,600 feet east of North Curtice Road up to the Cedar Point National Wildlife Refuge, is a swampy area covered with cattails, phragmites, and occasional ponds. Included in this swamp is an outlet for a small tributary of Wolf Creek, which is located to the south of the site. It is probabable that other small streamlets ran through the poorly drained woods to the south of the site, though all these outlets have been obscured by the present high water table and the disruption of the natural drainage patterns due to artificial drainage ditches.

Project Scope

The purpose of this study is to assess the significance of the Maumee Bay Site (33-Lu-247) and to determine its eligibility for inclusion in the National Register of Historic Places. This assessment was accomplished through the implementation of a testing program outlined in a research design aimed at a specific set of questions to be answered. The first objective was a determination of the physical boundaries of the site, including determinations of the horizontal and vertical distribution of the cultural deposits. The second objective was to determine how much of the cultural deposits presently exist in undisturbed contexts and whether or not such deposits contain information of significance. If the site was found to be significant, appropriate mitigation measures were to be recommended.

II. BACKGROUND

Local Environment

Lake Erie, like all of the Great Lakes, is a product of Pleistocene glaciation. The lake basin resulted from erosion of a preglacial stream valley which has since been obliterated (Pratt 1981:17). The present lake basin is actually composed of three separate basins underlain by different bedrock materials. The western basin is underlain by Silurian and Devonian Period limestones and dolomites, and the central and eastern basins of the lake are underlain by Devonian Age shales. The varying hardness of these bedding materials caused differential erosion of the three basins, resulting in deeper lake levels over the softer, shale-bedded central and eastern basins of the lake. The water level at 13,000 B.P. was close to the present day levels of the lake (Graves 1977).

The outlet of the lake, located on the Niagara Peninsula, was isostatically depressed due to the ice mass resting on it. As the ice melted from 13,000 to 12,000 B.P. due to climatic improvement, the Niagara outlet was opened and caused a drop in the lake water levels of as much as 150 feet (Dreimanis 1977: 80). As a result, the western basin of the lake was completely drained and the central and eastern basins were left with much smaller lakes. The subsequent geologic history of the lake from 12,000 B.P. to the present is one of rising water levels due to isostatic rebound occurring at the Niagara outlet and to climatic shifts which have produced varying amounts of precipitation.

During the period from 13,000 to 11,000 B.P., the western basin of Lake Erie was probably a relatively dry plain, containing small lakes and swamps in the lowest areas and well-drained woodlands at the higher elevations. The basin was traversed by several major rivers, extensions of the Detroit, Maumee, and others which drained into the lakes of the central and eastern basins (Pratt 1981). Pollen cores suggest that the area had a boreal parkland environment with a cool and moist climate (Ogden 1977). The dominant forest associations at the time were spruce, fir, pine, and aspen with megafauna of post-glacial environments including mammoth, mastodon, and giant beaver.

In the period from 11,000 to 10,000 B.P., a warmer and drier climate was established as evidenced by a decline in spruce pollens, coincident with an increase in deciduous hardwood species such as oak (Ogden 1977). Megafauna were replaced by smaller mammals which continue to occupy the area. From 10,000 to 6,000 B.P., the warming trend and concomitant increases in deciduous hardwood associations continued with oak and hickory becoming dominant. Lake levels during this period were rising very slowly, presumably due to isostatic rebound of the Niagara outlet. Precipitation levels for this period were too low to have significantly affected the rise (Pratt 1981).

The "Xerothermic Interval" (Sears 1942), 6,000 to 4,000 B.P., represented a maximum in the warm/dry trend of the post-glacial climates and in the hardwood forest associations of oak and hickory. Following this period, from 4,000 to 2,000 B.P., deterioration in the climate toward more modern conditions is suggested by the increase in beech/maple forests in the wooded uplands and swamp forests in the poorly drained areas (Forsyth 1973). Concomitant with this

climatic deterioration and the continued isostatic rebound of the Niagara outlet was a significant rise in the water levels of the lake. By 2,000 B.P., the lake level was within ten feet of its present level and portions of the western basin were inundated for the first time since the immediate post-glacial period (Forsyth 1973, Pratt 1981). The lake attained essentially modern levels after 500 B.P. (Graves 1977) with the maximum rise occuring during a period known as the Little Ice Age, c.1400-1850 A.D. (Pratt 1981).

Prehistoric Overview

People first entered the New World during the latter period of the ice age or Pleistocene epoch. During this time, periodic formations of ice sheets grew to continental proportions in the upper northern latitudes of the world. Cooler climates prevailed and in the tropical and temperate regions, mountain glaciers increased in size at high elevations. These periods of glaciation were often interrupted by longer interglacial periods which were characterized by conditions similar to those existing today.

It is the last glacial period (The Wisconsin Stage, c.70,000-10,000 B.C.) and the following post-glacial period that are of primary concern to American archeologists. During the Wisconsin Stage, a land bridge was exposed connecting Siberia and Alaska (due to a drop in sea level of 400 feet), thus allowing the peopling of the New World by hunters and gatherers from eastern Siberia.

Paleo-Indian Tradition

The earliest recognized prehistoric population on the North American continent consisted of groups of hunter/gatherers referred to by archeologists as Paleo-Indians. They ranged over a wide geographic area of this hemisphere from Alaska eastward to the Atlantic coast, and as far south as the southernmost extent of the continent. Their hallmark is a distinctive type of projectile point easily recognized by the presence of single or multiple flake scars which run vertically from the base of the artifact upward towards its tip. It is because of this particular manufacturing technique that these tools are collectively referred to as fluted points.

Fluted projectile points were first discovered in the mid-1920's on a number of southwestern United States sites in direct association with the bones of extinct ice age mammals such as giant bison and mammoth. The majority of these finds were "kill" sites and their subsequent reporting led to the conceptualization of this early human population as a "big game hunting tradition" (Willey 1963:37). Fluted points are fairly well-distributed throughout the northeastern United States; however, to date none have been found in association with the remains of mastodon or mammoth. In the western basin area of northwest Ohio, fluted points have been found in diverse physiographic settings such as upland, bluff edge, and floodplain locales, though all have been recovered from surface contexts (Stothers and Pratt 1980a:2). Evidence from several excavated northeastern Paleo-Indian sites suggests alternative resource exploitation patterns.

The Holcome Beach Site in Michigan (Fitting, *et al.* 1966) and the Dutchess Quarry Cave Site near Florida, New York (Funk, *et al.* 1969) have both yielded the bones of caribou. More recently, the Meadowcroft Rockshelter in southwestern Pennsylvania (Adovasio, *et al.* 1977) and the Shawnee-Minisink Site in the upper Delaware

valley (Dent and Kaufman 1978) have both yielded a surprising number and variety of charred wild plant remains associated with Paleo-Indian horizons. It may be that the importance of big game to the subsistence of Paleo-Indians has been grossly overstated. This is further supported by archeological investigations being conducted to the east in the metropolitan Washington area. Excavations and surveys have been underway in the Shenandoah River valley during the past five years by Gardner and others. He (Gardner 1974) has presented a "counter theory" of the subsistence and settlement patterns of the Paleo-Indian peoples which can be applied to Ohio.

Gardner and associates suggest that the Paleo-Indian people, rather than emphasizing the hunting of large game animals, maintained a procurement system that was oriented toward the exploitation of multiple floral and faunal resources. Settlements, as indicated by the Shenandoah River valley investigations, are often determined by the presence of the areas in which multiple resources can be simultaneously exploited. Thus, a Paleo-Indian settlement might be expected in an area where raw lithic materials outcrop which are also near a river floodplain or a swampy or marshy area adjacent to or near upland hunting areas.

The Paleo-Indian occupation of northwestern Ohio closely resembles that of Paleo-Indian occupations found throughout the northeast. The point types found in the region include Clovis, Folsom, Enterline, Barnes, and Parkhill. Paleo-Indians are thought to have entered the region from the southeastern United States as they followed the game animals moving northward as the glaciers retreated. One exception to this northward migration was the introduction into the area of a late Paleo point style known as "aqua-plano" (Quimby 1960; Fitting 1975:59) from the western plains area of the United States (Stothers and Pratt 1980a:5).

These early people would have encountered boreal parkland or park-tundra environments (Fitting 1975:35), which supported megafaunal species such as mastodon, mammoth, caribou, horse, and giant beaver until about 9,000 B.C. At that time, the environment shifted to spruce-hardwood forests concomitant with climatic shifts and the retreat of the glaciers. The relatively low carrying capacity of parkland and tundra environments may seem to interfere with the application of Gardner's model of multiple resource exploitation to the Paleo-Indian occupations in this part of Ohio, but several external factors need to be considered. First, even in parkland and tundra environments, a variety of microenvironments are present. The second factor is the high degree of mobility ascribed to these bands of hunter/gatherers, and the third is a low population density as indicated by the scarcity of artifacts. All of these factors combined tend to reduce the importance of carrying capacity when considering the subsistence and settlement patterns of Paleo-Indians. The lack of data from excavated Paleo sites makes it difficult to describe in any detail the activities of these early people, although the general outlines of their lifestyle can be deduced from what little data are available.

Archaic Tradition

The end of the Pleistocene was marked by warmer temperatures resulting in glacial melting and a subsequent rise in the water levels of the Great Lakes. There was also a shift in surface cover from parkland to a northern or boreal spruce-pine forest and in later times to a mixed deciduous environment. Many of the

cold-adapted animals probably followed the retreating glaciers northward and in the case of mammoth and mastodon, into extinction. These populations were replaced by deer, elk, bear, and smaller mammals.

During this period, there was a change in the style of projectile points and new items were added to the tool kit. The technique of "fluting" points was abandoned and the resulting change in projectile point form has been used to mark the end of the Paleo-Indian tradition and the beginning of the Early Archaic.

Recently, it has been suggested that a change to notched points does not necessarily make a new tradition (Gardner 1974, Bryan 1977). It has been argued that late Paleo-Indian and Early Archaic people made their living in much the same way, that is by hunting/gathering and the exploitation of similar resources in similar environmental settings. In other words, they view the Early Archaic as a continuation of the Paleo-Indian tradition. Nevertheless, the Archaic tradition as a whole can be charcterized by more specialized forms of technology than had existed at the end of the Paleo-Indian tradition. Of special note are the ground stone woodworking implements considered necessary for the successful exploitation of woodland environments. During the Archaic, the tool inventory continued to become more diverse and probably more specialized.

The Archaic tradition developed through a number of stages or cultural periods which can be defined by artifact forms. The Early Archaic was succeeded by a more widespread Middle Archaic and then, with a major shift in settlement, by a Late Archaic or Terminal Archaic. The recognition of modifications not only in artifact styles but also in economic patterns has led some scholars (*e.g.*, Caldwell 1958) to postulate a continuing development of "forest efficiency" among the Indian populations of the eastern woodlands.

In northwestern Ohio, the Early and Middle Archaic occupations are the least understood manifestations, as no sites dating to these time periods have been excavated (Stothers and Pratt 1981). During this period (8,000 to 4,000 B.C.), the entire Western Basin west of the major Erie Islands was exposed due to significantly lower lake levels than at present. These areas would have had great potential in terms of riverine and lacustrine resource exploitation. Also, the area known as the Black Swamp Region of northwestern Ohio would have been an upland forest area until rising lake levels flooded the remainder of the Western Basin (Pratt 1981). Early and Middle Archaic sites are at present defined on the basis of point types dated in other regions of eastern North America. Archaic artifacts are recovered from a variety of sites in the Western Basin. Some of the assemblages are from multi-component sites and are mixed with artifacts from a variety of other time periods. These sites are numerous and indicate that Archaic people were widely distributed throughout the region.

The few sites containing relatively undisturbed Early and Middle Archaic components are primarily found in the Black Swamp area. Pratt (1981) suggests these small components represent the fall-winter aspect of a settlement system which relied heavily on the riverine and lacustrine resources available in the Western Basin prior to its inundation. This theory is supported by the recovery of water-worn Archaic artifacts from sites such as the Maumee Bay site.

The Late Archaic Period from 4,000 to 500 B.C. is the earliest period in northwestern Ohio from which excavated and dated remains have been recovered. A clear

pattern of resource exploitation emerges, probably due to the more stable environmental conditions existing at that time. The subsistence settlement pattern indicates heavy reliance on riverine and lacustrine resources during the spring and summer, and then movement to upland wooded areas in the fall to exploit the abundance of nuts and deer. The final leg of the subsistence system would have been a move to even more interior areas. The winter would have been spent foraging for roots, hunting deer, elk, and bear, and trapping small game. These upland areas also provided better cover from harsh winter winds than river valleys, and would have avoided the common flooding which occurs every spring in the major river valleys of the Western Basin of Lake Erie (Stothers and Pratt 1980a).

It is also during the Late Archaic that elaborate mortuary activities appear, coupled with ceremonial artifacts made of exotic materials, implying trade with neighboring people. Burial pits, often containing 50 to 60 individuals interred with such objects as tubular pipes, birdstones, and shell beads, indicate a great degree of social cohesion within the Late Archaic population of the area. The Williams Site, excavated by Stothers in 1977, provides a good example of these elaborate funerary practices. Over 18 ossuary pits containing multiple burials were excavated in which individuals were interred in many different modes and with a varied array of artifacts (Pratt 1981:55-59).

Woodland Tradition

Just as a period of transition occurred at the end of the Pleistocene between traditions based on the utilization of fluted points and those of more diversified projectile points, a similar transition separated the Archaic tradition from the Woodland tradition. For purposes of discussion, it is convenient to consider the Woodland as beginning with the introduction of ceramics.

The earliest Woodland manifestations recognized are characterized by the presence, on most if not all sites, of an incipient pottery industry. The Early Woodland pottery-using people apparently led a life much like that of the Archaic people who preceded them. Although it is felt by some that Early Woodland and possibly even Late Archaic people enjoyed the knowledge of plant cultivation, this has not been confirmed in the eastern United States.

Later Woodland traditions in the eastern United States vary considerably in the diversity of economic practices as well as in the recognized styles of their artifacts. This may be due to tool kit diversity or merely to stylistic differences. During the late part of the Early Woodland and initial periods of the Middle Woodland, the introduction of plant cultivation is probable and the existence of a more settled village life can be demonstrated (Gardner and McNett 1971:49). At the same time, we find evidence of the existence of extensive exchange networks involving the transfer of goods from the continental interior to the Atlantic coast, as well as north and south along coastal and interior travel routes (Ford 1958, Thomas 1970).

Middle Woodland traditions appear to continue the lifeways that became established during Early Woodland times. While it is possible that shifts in subsistence occurred from a diversified economy depending on both hunted and produced foodstuffs to one of greater dependence on plant cultivation, there is little if any change in settlement pattern between Early and Middle Woodland times.

The non-Hopewellian Western Basin Middle Woodland tradition is thought to relate to a series of "northern tier" Middle Woodland assemblages known by regional names such as Laurel, North Bay, Saugeen, and Point Peninsula, which have been termed "Lake Forest Middle Woodland" (Fitting 1978:49-51) on the basis of similarities in material culture, temporal placement, and ecological adaptation (Stothers and Pratt 1980a). Heavily decorated, tool-impressed ceramics appear for the first time along with new point types similar to Jacks Reef corner notched and Levanna-like triangles (Ritchie 1961). Differences in burial practices are also seen in which mound burials are still practiced but in which fewer grave offerings are found.

The subsistence-settlement pattern for the Middle Woodland in the Western Basin remained essentially unchanged from that of the Late Archaic and Early Woodland, still relying heavily on riverine and lacustrine resources. The Western Basin is regarded as a transitional area in which the local populations developed subsistence systems having characteristics of the northern and southern tier. It is not until late in the Middle Woodland (500 A.D.) that horticulture became established and the outlines of the Late Woodland culture emerge (Stothers and Pratt 1980a).

The Late Woodland is marked by a radical shift in the subsistence-settlement patterns including the appearance of small villages occupied on a year-round basis and supported by smaller temporary seasonal camps. This change is seen as being a direct result of dependence on full-scale agriculture. The change in the subsistence pattern is also seen as having fostered radical changes in the social organization essential to the maintenance of the subsistence system (Pratt 1981). Two distinct Late Woodland occupations have been defined in the area, the Younge Phase (1000-2000 A.D.) and the Springwells Phase (1200-1400 A.D.). These phases are characterized by an increased emphasis on the village as a social unit (Pratt 1981). Villages generally have associated cemeteries and are sometimes stockaded, indicating that conflict may have occurred between different social groups, possibly caused by population pressures. There are also changes in burial modes in which post-mortem mutilation is practiced. The ceramics associated with these phases are a continuation of the heavily decorated, tool-impressed types found in Middle Woodland times with minor modifications in decorative motifs and vessel form.

The final phase of cultural development in the western basin region relates to a cultural phenomena known as the Sandusky Tradition (Stothers and Pratt 1980b). This tradition is marked by the introduction of upper Mississippian influences into the Sandusky Bay region sometime around 1300 A.D. After becoming established in the Sandusky region, Mississippian people moved westward into the Maumee Bay region, thereby forcing the Western Basin people of the Springwells Phase northward into Ontario. Two cultural phases have been identified in the Maumee Bay region as belonging to the Sandusky Tradition, the Fort Meigs and the Indian Hills Phases.

Although little work has been done to date on sites associated with the Fort Meigs and Indian Hills Phases, limited excavations at the Indian Hills site have clearly shown strong Mississippian influences, including the introduction of a new artifact assemblage of shell-tempered ceramics and bone and shell tools not previously seen in the area. Large village sites occur which seem

to be organized along classic Mississippian lines with wattle and daub structures surrounding a central plaza, and the whole enclosed in a palisade. The cultivation of beans and an increase in sedentism are indicated by the lack of specialized procurement camps associated with village sites. By the time of European contact, the Mississippian cultures seem to have spread throughout the entire Western Basin region, and to have imposed their technological and cultural aspects on all the local Late Woodland populations of the region.

III. METHODS OF DATA RECOVERY

Research Design

The following research design was constructed prior to the initiation of a Phase II field survey and was intended as a model for the testing and evaluation of the multi-component Maumee Bay Site, 33-Lu-247. According to Pratt (1979:12), the site has produced a large assemblage of prehistoric artifacts which span every prehistoric tradition from Paleo-Indian to Upper Mississippian times. Pratt's initial surface reconnaissance of the site succeeded in isolating one locus of prehistoric cultural activity as evidenced by a sherd of grit-tempered pottery, an endscraper, and several fragments of lithic debitage. Unfavorable field conditions and time constraints did not permit additional testing.

The horizontal and vertical extent of the site was left undetermined and could not be firmly established because most of the cultural materials were recovered from beach deposits in mixed surficial contexts. It also appeared that a large portion of the site might be underwater on in contexts characterized today by swampy or marshy conditions. Since the level of Lake Erie has been rising at various rates since about 10,500 B.C., when the level may have been as much as 150 feet lower than it is today (Pratt 1979:2-4), the various cultural occupations evident at the site may correspond to a series of successively higher ancient beach deposits, culminating in the deposit representing the current shoreline. That is, late prehistoric materials may be limited in areal extent to the present shoreline, while Paleo-Indian materials may be considerably further out in the water with intervening cultural manifestations occupying ancient beaches in between. The cultural mixing evident in the surface collections from the site, accordingly, may be attributed to erosional or hydrological factors.

In furtherance of the project purpose and objectives, outlined previously, goals of the investigation were to ascertain the nature of cultural deposits at the site and to determine their areal extent and stratigraphic integrity. An additional goal was to evaluate the erosional and depositional processes presently affecting the site. Due to the extraordinary environmental factors present at the site, several field techniques not applicable to wholly terrestrial sites were developed and implemented for this investigation. The methods of data recovery described herein address the particular field conditions as well as the overall project goals and objectives.

Surface Testing

Surface testing consisted of random and controlled surface collections of artifacts. The random collections included the examination of all exposed beach surfaces, eroded banks, and uprooted trees. Artifact provenience was noted in order to define areas of artifact concentration to guide the location of intensive controlled surface collections.

Controlled surface collections were carried out primarily on the exposed mud flats north of the present shoreline. As explained previously, the mud flats were only exposed during periods of wind from the southwest. Due to the size of the area to be collected and the unpredictability of wind shifts, time was not available to survey in standardized collection units established by a transit.

Pacing was therefore used to establish a collection grid of units 150 x 150 feet square. These units were carefully walked and examined for artifacts. A minimum of 30 passes was made within each of the collection units to assure complete coverage and the recovery of an adequate sample of cultural material. The artifacts from each unit were marked with their unit designation and bagged separately for later analysis.

Subsurface Testing

Subsurface testing consisted of the excavation of test pits and auger probes at regular and irregular intervals using a variety of tools. The standard excavations were 2-1/2 x 2-1/2 feet square units excavated to a depth ranging from 18 to 36 inches (Plate 10). These units were excavated with round and flat shovels. Vertical control was maintained by carefully observing the excavations in progress and by excavating in levels of natural deposition when such levels could be discerned. The artifacts recovered were kept separate by unit and level. Once each unit was completed, its walls were cleaned with trowels and the stratigraphy was recorded. Each depositional level was measured and the soil matrix was described in terms of composition, texture and color using standard Munsell notations. Photographs were taken of several test units. All excavated soil matrices were water screened through 1/4 inch mesh hardware cloth to insure maximum and standardized artifact recovery. The horizontal location of each test unit was mapped on a base map (scale one inch to 400 feet) provided by the Corps of Engineers. At the end of the survey, all test units were backfilled in order to restore the survey area to its original condition.

Subsurface testing was also conducted on the underwater portion of the site and on the section of poorly drained woods just south of the beach. Auger tests were excavated using a hand held bucket auger and a power auger (Plate 12) fitted with an eight inch drill bit. The soil excavated in this manner was retained in a large washtub with a ten inch hole cut through the bottom, and was later removed and water screened through hardware cloth. A clam rake was also used in the subsurface testing of the submerged segments of the site. The rake has a row of teeth much like a conventional garden rake and a large, built-in basket which was lined with 1/4 inch mesh hardware cloth. After the rake was dragged through the mud and silt bottom of the lake, it was raised and the contents were water screened and examined for artifacts left in the mesh basket (Plate 11). All the underwater areas of the site tested in this manner were plotted on the project base map (Figure 3).

Existing Data Review

The existing data review consisted primarily of interviews with local professional and avocational archeologists familiar with the site and the archeology of the vicinity. Advice and opinions on how best to approach the problems encountered were sought from professional archeologists at the University of Toledo and the State Historic Preservation Office. Maumee Bay State Park personnel were also interviewed and local avocational archeologists' collections from the area were examined and photographed. A review session on the archeology of the Western Basin of Lake Erie was held at the University of Toledo in which the survey findings were discussed. Also, the library at the University was used to obtain bibliographies, books, and other publications useful in the preparation of the final report.

The final part of the research design concerns the data analysis. All prehistoric artifacts recovered were cleaned and inventoried. Where possible, artifacts were identified as to material, temporal or cultural affiliation, style, and function.

IV. FIELD INVESTIGATIONS

Sampling Procedures

Initial testing of the Maumee Bay site consisted of a complete pedestrian survey of the lake bank starting at North Curtice Road and extending some 6,000 feet east to the beginning of the Cedar Point National Wildlife Refuge (Figure 3). Based on the resulting observations, an approach to testing the site was selected. The approach consisted of dividing the 6,000 feet of lake bank into three separate survey segments, based primarily on existing topography and vegetation (Figure 2). This was done to facilitate control of provenience and to simplify the mapping procedures. The testing proceeded from west to east, beginning at North Curtice Road.

A datum was established at the end of the dirt road, 1,150 feet east of North Curtice Road. An attempt was made to tie the datum into a U.S.G.S. benchmark located at the end of North Curtice Road, but failed when the benchmark was discovered uprooted and pushed off the side of the road into the woods. The area was so overgrown that it was not possible to locate the original position of the benchmark.

The first segment extends to a point 1,350 feet east of North Curtice Road. The U.S.G.S. topographic map for the area, dating to 1967, indicates a series of eighteen beach cottages in linear arrangement along the beach. Immediately south of the cottages is a dirt road extending to the end of the segment paralleling the shoreline. The U.S.G.S. map indicates the land south of the dirt road as well-drained cropland. Presently, the area between the dirt road and the shoreline is sparsely wooded, and fields south of the road are fallow. The beach cottages were removed when the land was acquired by the state and the concrete foundation pads were broken up and placed on the beach to form a revetment for erosion control (Plate 1).

The testing of this segment included the excavation of two test units (Nos. 1 and 2). Test Unit 1 was located at datum and Test Unit 2 was located 50 feet due south (Figure 4). The recorded profiles of both test units indicated that the area has been severely disturbed. The profile of Test Unit 1 (Figure 5) revealed the presence of eight different levels of fill. Most of the levels were composed of sands containing varying amounts of gravel and clay. The test unit was excavated to a depth of 23 inches, at which point water seepage prevented further excavation. Artifacts were recovered from all levels encountered except the deepest level, which was composed of ashes and cinders. The artifacts were all architectural in nature and included glass, metal, tile, brick, nails, and chunks of concrete and cinder block. The artifacts and fill levels all point to severe disturbance undoubtedly related to the demolition of the aforementioned beach cottages. Additional testing of this segment was not deemed necessary, since Pratt in his initial Phase I survey (Pratt 1979:26) excavated a transect of test units at 20 meter intervals south of the dirt road, all with negative results. Additionally, the concrete revetment precluded surface collection of the beach and at no time was any portion of the beach north of the revetment exposed.

The second survey segment extends from a point 1,200 east of North Curtice Road to a point 3,200 feet east of the road. The U.S.G.S. topographic map shows the shoreline with poorly drained woods to the south (Figure 2). Presently, this section of the shoreline is cluttered with dead trees and debris brought to shore by storms. The beach is composed of a narrow berm of sand 10 to 25 feet wide and one to two feet above the present level of the lake. It separates the lake from the poorly drained woods immediately south of the shoreline. The poorly drained woods are slowly being encroached upon by phragmites and cattails. All the trees are either dead or dying and there are 12 to 18 inches of standing water, probably due to the sand berm which prevents the natural drainage of the woods. It is in this segment that the bulk of the testing was conducted. It included random and controlled surface collections, auger tests, raking, and the excavation of 29 test units along the beach and in the few areas of fast land south of the beach.

The initial testing of this segment, a random surface collection of the beach and shoreline, yielded very little in the way of prehistoric artifacts. Artifacts recovered include approximately a dozen waste flakes and three sherds of grit-tempered pottery. Historic artifacts of the late nineteenth and twentieth century were scattered the length of the beach, though the majority were in a dump area immediately adjacent to the beach cottages and Segment I. The prehistoric artifacts seemed to be confined to two separate areas of the shoreline. These areas were designated Locus 1 and Locus 2 (Figure 3).

The next phase of the testing consisted of controlled surface collections on the exposed mud flats north of the two loci and random surface collections in the area between the two loci and east of Locus 2. Six separate surface collections of the mud flats were made in the course of the survey. These surface collections were conducted only when the prevailing winds were out of the southwest, as this was the only time when any significant portion of the beach was exposed (Plates 7 and 8). The technique of controlled surface collection was abandoned, however, when it became obvious that due to the small number of artifacts being recovered, no patterning in the distribution of the artifacts could be observed. This decision was also made because of the rapidity with which the winds shifted, causing the water level to rise and cover the flats.

Prehistoric artifacts, including most of the diagnostic material recovered, were found in the course of the surface collections. Although 250 to 300 feet of mud flats were surface collected, the great majority of the artifacts recovered were found within 100 feet of the present shoreline. Visibility on the mud flats was excellent and artifacts were easy to see with the exception of pottery which often was the same color as the mud. The surface collections also allowed more precise definition of the loci. Locus 1 was established as extending 560 feet from 1,170 to 1,730 feet east of North Curtice Road and Locus 2 as extending along 300 feet of shoreline from 2,400 feet to 2,700 feet from the road (Figure 4).

The next phase of testing in this segment included the use of a clam rake to recover artifacts underwater and the use of a hand held bucket auger and a power auger to establish the stratigraphy of the underwater and poorly drained wooded portions of the site. The rake was used in six test areas. Two transects, 150 x 400 feet, were raked north of the two loci, as were three 100 x 100 feet squares in the area between the two loci, and one 100 x 100 feet square east of Locus

2 (Figure 3). A total of three flakes was recovered with the rake from the test area fronting Locus 1. No artifacts were recovered from the other test areas. Attempts at augering failed, primarily because of the nature of the unconsolidated muds and silts encountered. The bucket auger and the power auger were not able to lift the soil.

The final phase of testing consisted of the excavation of 29 test units, 2-1/2 x 2-1/2 feet square. Nine test units were excavated in Locus 1, eight test units in Locus 2, two in the area between the loci and ten units east of Locus 2 (Figure 4).

Of the nine test units excavated at Locus 1, six were placed on the beach at 100 feet intervals and three were placed 50 feet south of the shoreline in the poorly drained woods. The test units on the beach were excavated from a minimum depth of 16 inches to a maximum depth of 27 inches. The profiles of Units 4, 7, and 10 (Figure 6) indicate the presence of two to four strata of alluvial sands overlying a stratum of black muck. Water was encountered at depths of 12 to 16 inches. Historic artifacts, including some of very recent origin, were recovered in all the sand levels. A single flake of grey chert, the only prehistoric artifact recovered, was from the top level of Unit 10. The three test units excavated in the poorly drained woods produced only twentieth century artifacts. These units were excavated to a depth of 26 to 31 inches into the black muck stratum encountered in the units excavated on the beach. All three of these units have a sand stratum four to eight inches thick, overlying dark greyish-brown clayey loam 12 to 16 inches thick (Figure 7). The sand stratum represents wash overlying what may be a topsoil or an old plow zone. This topsoil or plow zone is above a narrow band of sand two to five inches thick which in turn rests on the muck. Historic artifacts recovered from these units were confined to the sand stratum and the buried topsoil/plow zone level. No prehistoric artifacts were recovered.

Two units (Nos. 11 and 12) were placed between Locus 1 and 2. Unit 11 was placed at the 2,050 foot mark and Unit 12 was placed at the 2,150 foot mark. The profile of Unit 12 (Figure 8) indicates four strata of alluvial sand overlying a level of black muck. No artifacts were recovered from either of the units.

Of the eight units excavated at Locus 2, five were placed on the beach at 25 and 50 feet intervals and three were placed 50 feet south of the shoreline in the poorly drained woods. The five test units on the beach were excavated to depths ranging from 17 to 31 inches. All of these units had two or three levels of alluvial sand overlying a level of black muck. Test Units 5 and 6 (Figure 9) produced prehistoric and historic artifacts mixed throughout the sand levels. Unit 5 produced four flakes and a biface fragment, while Unit 6 produced a single flake of tan chert. The three units excavated in the poorly drained woods south of the shoreline of Locus 2 were excavated to depths of 25 to 30 inches (Figure 9). These units had four to six strata of alluvial sand overlying a level of black muck. The clayey loam found in the units at Locus 1 is absent at Locus 2. No artifacts were recovered in any of these units.

The last ten units, east of Locus 2, were excavated to depths of 25 to 36 inches. Eight of these units were placed on the beach at 50 feet intervals and two were placed 25 and 50 feet south of the shoreline in the poorly drained woods. All

of the unit profiles (Figure 10, Units 20 and 22) recorded one to three levels of alluvial sand overlying a level of clayey loam 6 to 8 inches thick, which in turn rested on a shallow level of sand separating it from the black muck. Four of the units (Nos. 18, 19, 26, and 27) produced flakes, all from the top level of brown sand. The dark clayey loam level is identical to the level identified as a topsoil/plow zone level found in the poorly drained woods behind Locus 2.

The third survey segment extended from Locus 2 eastward to the boundary of the Cedar Point National Wildlife Refuge. This segment is very low and composed entirely of swamp. The area is covered with phragmites, cattails, and stream outlets or ponds. When the lake water level is high, the shore can be distinguished only by the presence or absence of swamp vegetation. There is no beach sand and the shoreline is no longer obstructed by trees. This segment was tested by a random surface collection conducted on a narrow strip of mud flats along the edge of the swamp. The area was entirely devoid of artifacts, prehistoric or historic.

Artifact Recovery

The inventory of artifacts recovered during the investigation is somewhat meager. Of the various methods employed, the most successful was the surface collection of the mud flats north of Locus 1 and 2. All the diagnostic material was recovered as a result of these collections. The attempts at augering were not practical or productive. The raking procedure produced few artifacts despite the great deal of effort expended. Finally, the test excavations, though not producing large quantities of artifacts, did produce data concerning site stratigraphy and the effects of the hydrological factors.

Recordation

Mapping of the site and test areas was accomplished by carefully pacing distances. Pacing was selected as the most efficient means of maintaining horizontal control through the dense vegetation and other obstacles presented by the site. Measurements obtained in this manner are within two percent of those reported by Pratt (1979) and are of sufficient accuracy for a Phase II investigation.

The very high water table, encountered between 12 and 16 inches below surface, necessitated rapid recording of the test units. Water seeping into the units also made it difficult to distinguish strata and to record their depths.

Constraints

In order to best accomplish the project goals, field methods were adopted to meet the difficult working conditions presented by the site. The terrain and vegetation encountered resulted in numerous problems not usually faced in archeological fieldwork. Access to the site by land was extremely difficult and time consuming, due to a dense tangle of fallen trees and other debris in the poorly drained woods and along much of the shore (Plates 3, 4, 5, and 6). Access to most of the tested areas was made by wading along the margin of the bay, although this was not without difficulties. Submerged trees and holes, the slippery clay lake bottom, and the awkwardness of wearing waders and carrying equipment combined to make access by water treacherous. In addition, the water depth was often

greater than indicated on the topographic map. The limiting depth of four feet (Appendix III:4) was reached in many areas within 200 feet of the shore. Strong winds and the resulting waves further exacerbated the difficulties of working in the submerged portions of the site.

V. DATA ANALYSIS

Discussion of Artifacts

For purposes of this analysis, artifacts are grouped by locus. The locus designation of provenience was selected as the appropriate unit of analysis because all of the diagnostic artifacts were recovered from the surface and because subsurface artifacts were not recovered *in situ*. The loci represent separate, although probably contemporaneous, occupations of the site.

A total of 89 prehistoric artifacts was recovered in the course of the survey. This total includes: 55 waste flakes, 20 sherds of pottery, nine whole and fragmentary bifaces, two celts, one projectile point, one fire-cracked rock, and one fragment of a ground stone tool. Forty-two percent of the artifacts were recovered from Locus 1, 48 percent from Locus 2 and the remaining 10 percent from east of Locus 2 (Figure 3). All of the artifacts recovered are typical of artifacts found in the Western Basin area and all are made of locally available raw materials. The flakes are of jasper or cherts available from small outcrops and cobbles probably obtained from the Maumee River. The ground stone tools were made of basalt and slate which are also locally available.

The artifacts from Locus 1 (Plate 19) include a triangular point of white chert exhibiting very little edge wear or water damage, a slate celt with severe edge attrition, and three non-diagnostic bifaces which are of crude manufacture and exhibit heavy-use wear. One of these crude bifaces has a small spur with heavy retouch indicating possible use as a graver. The only other artifacts recovered were 13 sherds of pottery found concentrated in a small area of mud flat. This pottery concentration was designated Feature 1 (Plate 17).

The artifacts from Locus 2 (Plate 20) include four sherds of grit-tempered pottery, four whole and fragmentary bifaces, and one celt made of basalt. Of the four bifaces, one is a large point tip made of basalt and another is a lanceolate-like point made of jasper. The two remaining bifaces are small and fragmentary. All of the bifaces were recovered from the beach and are heavily water-worn.

The remaining artifacts were recovered from the bank east of Locus 2. They include five flakes, one fragmentary biface of crude manufacture, and three sherds of grit-tempered pottery (Plate 18) recovered from Level 1 of Unit 19 (Figure 4).

Remaining artifacts to be discussed are those collected over the past ten years by Mr. Gene Paulsen of Genoa, Ohio. Mr. Paulsen's collection is comprised of approximately 250 whole and 300 to 400 fragmentary artifacts, all recovered from the beach at the Maumee Bay site. Mr. Paulsen reports that most of his artifacts were recovered eroding out of the bank, generally after storms had buffeted the shoreline. The fact that the artifacts are being eroded out of the bank rather than being brought into shore from the bay is confirmed by the almost total absence of water-wear on Mr. Paulsen's collection. Mr. Paulsen also reported that possibly as much as a quarter mile of land has been lost to erosion since he first started collecting the site in 1970. Hurricane Agnes, in 1972, caused a great deal of damage and deposited most of the trees and debris presently found on the shore and in the poorly drained woods south of the site. Mr. Paulsen indicated that he has found very few artifacts in the last two or three years and that he believes the site has been nearly depleted.

The artifact assemblage represented by Paulsen's collection is quite extensive (Plates 13-16). Every period of prehistory is represented by his collection, from the Early Archaic to the Late Woodland. The only occupation not represented is the Paleo-Indian period, although Paleo artifacts are documented at the site from the Frank Schmidt collection (Pratt 1979). Another notable absence in Paulsen's collection is pottery. The Woodland components are well represented by lithics, but Mr. Paulsen collected only two sherds of pottery. This is probably due to collector bias, and the fact that the pottery is difficult to see on the mud flats.

Discussion of Features

A single feature, a concentration of pottery, was identified within an area ten inches in radius during the course of the survey at the Maumee Bay site. The feature was located on the mud flats at Locus 1, 25 feet north of Test Unit 7 (Figure 4). The pottery was embedded in the clay, with sherds lying on top of one another, suggesting that they were at the bottom of what had once been a deeper feature. The area around the concentration was carefully scraped and inspected for soil anomalies. No discolorations were observed. The pottery was cleaned, photographed, and carefully removed from the clay matrix. A total of 13 sherds, all grit-tempered and thin walled (6 to 7mm), was recovered from the concentration. One exhibits faint cord markings on the interior, but other surfaces of the sherds seem to be undecorated, though water may have eroded away any impressions. In spite of the fact that no diagnostic rim sherds were recovered from the concentration, the type was identified as being "Parker Festooned" (Pratt, personal communication), a Late Woodland ceramic dating from 1300 to 1500 A.D.

Discussion of Stratigraphy

The stratigraphy of the Maumee Bay site has been formed by natural erosional and depositional processes and by cultural activities. The first survey segment, extending east from North Curtice Road for 1,200 feet, has been disturbed by construction and demolition activities related to the beach cottages located along the shoreline. The second survey segment, extending from 1,350 feet to 3,200 feet east of North Curtice Road, has been subjected to extensive disturbance by natural processes. Conversations with Mr. Paulsen and with park rangers indicate that severe erosion along this segment of bank has resulted in the loss of possibly a quarter mile of fast land in the last ten years. Another long-time resident of the area informed the field team that the beach cottages were moved back two or three times prior to their demolition due to severe erosion. He also indicated that a regulation-size baseball field was once located in front of the easternmost cottage, now inundated by Maumee Bay.

The test unit profiles in the second survey segment indicate several episodes of deposition. The most obvious feature in the segment is the sand berm which separates the shore from the poorly drained woods. This berm acts as a reef and prevents drainage of the woods. The mixture of artifacts recovered from the top sand strata of the units indicates that most of the sand was deposited fairly recently. The test units excavated south of the beach in the poorly drained woods (Figures 4, 6, 7, and 10) all have a stratum which represents an original ground surface, referred to as a "topsoil/plow zone" level in the section of the report describing test units. This level is covered by one to three strata of alluvial sands, six to 18 inches thick and containing recent artifacts.

On several occasions when the winds were particularly strong and the wave action on the lake was high, the erosion was actually observed by the field team. The water encroached upon the mud flats and hit the sandy bank, undermining and eroding the bank at the rate of approximately one inch at a time.

Functional Analysis

The Maumee Bay site is composed of a series of small occupational or activity loci. The early occupations were probably located in areas presently submerged by the lake. These small encampments probably functioned as seasonal procurement camps from which riverine, lacustrine, and possibly wetland environments were exploited. The primary seasons of exploitation would have been the spring months when fish were readily available, the summer months when fish, small game, and a variety of edible plants and berries matured, and the early fall when migratory waterfowl inhabited the wetland areas adjacent to the lake. The artifact assemblage recovered from Loci 1 and 2 is not large enough to determine the complete range of activities carried out at the site. The presence of pottery at both of the loci implies that gathered food resources were processed, and the presence of celts implies woodworking activities were also carried out. Other activities cannot be determined.

Temporal Analysis

Both of the occupational loci remaining at the Maumee Bay site are Late Woodland. Based primarily on the identification of the ceramics from Locus 1 as being of the Parker Festooned type (Pratt, personal communication), the triangular point and the celt, the component represented at Locus 1 is Late Woodland, dating from 1300 to 1500 A.D. The identification of ceramics from Locus 2 as either Mixter-ware or Parker Festooned (Pratt, personal communication) also places Locus 2 in the Late Woodland period.

VI. SUMMARY AND RECOMMENDATIONS

Results

As stated previously, the investigation was designed to answer a specific set of research questions presented in the Scope of Work (Appendix II, Section 3.2). The results of this investigation may be summarized by discussing the topics presented by those questions.

Site Limits

Two areas, or loci, of prehistoric cultural material were identified. Locus 1 is located along the shore between 1,170 and 1,730 feet east of North Curtice Road and includes a narrow sand berm 10 to 25 feet wide south of the shore and a strip of mud flats that extends approximately 150 feet north of the shore (Figure 4). Locus 2 is also located along the shore and includes the sand berm and approximately 100 feet of mud flats. It is between 2,400 and 2,700 feet east of North Curtice Road (Figure 4).

Post-1979 Erosion

As no permanent markers were established during the initial survey (Pratt 1979), the change in shoreline since that time could not be exactly determined. Based on interviews with local residents and an on-site discussion with Pratt, it was determined that within the last two years the shoreline has moved inland a maximum of 25 feet at Locus 1 and a maximum of 10 feet at Locus 2. This shoreline retreat is minimal when compared to the total encroachment that has occurred during the past ten years.

Archeological Components

Both loci contained ceramic and lithic artifacts attributable to a Late Woodland component dating to c.1300 to 1500 A.D. Artifacts diagnostic of other components were not recovered during this investigation but are present in the Paulsen and Schmidt collections. In fact, these collections contain artifacts representative of every cultural tradition presently known in the western basin region, from Paleo-Indian through Contact Periods.

Underwater Extent

A model relating cultural occupations and rising lake levels was presented in the Professional Services Proposal (Appendix III). According to that model, the earliest components would be located further offshore and later components would occupy successively higher ancient beach levels up to the present shoreline. As predicted by the model and confirmed by the field investigation, the most recent prehistoric component, Late Woodland, was present near the existing shore. No evidence of earlier or later components was recovered inland from the sand berm paralleling the shore. It follows that the major portion of the site is currently submerged.

Three primary factors prevented a more precise delineation of the areal extent of submerged components. First, the very low density of artifacts precluded definition

of submerged activity or occupation areas. Second, artifacts that were recovered from the submerged portion of the site were not *in situ*, as evidenced by their water-worn condition. The third factor is that the four feet water depth, the limit of this investigation, was encountered approximately 150 feet offshore. The presence or absence of cultural material beyond this limit could not be determined.

Underwater Effects

The proposed riprap revetment will cover only a narrow strip of mud flats along the existing shore. Most if not all of the cultural material has been recovered through intensive and repeated surface collections.

Location of the Early Cultural Material

As discussed above, cultural material predating the Late Woodland component would have been deposited in the portion of the site currently inundated. The fact that earlier artifacts in the Paulsen and Schmidt collections are not water-worn is explained by two additional conditions. First, the artifacts were recovered soon after they had been exposed. Second, they were recovered from portions of the site which have been inundated within the past ten years and are far removed from the present shore.

Component Integrity

As evidenced by surface and subsurface testing, the Late Woodland component present at Loci 1 and 2 is discrete horizontally but is mixed vertically. Each locus occupies a distinct and separate surficial area. However, prehistoric artifacts were recovered only from surface contexts or from subsurface strata which also contained historic material, indicating that this component is no longer restricted to discrete vertical provenience.

Significance and Effects

Based on the investigation reported herein, the Maumee Bay Site, 33-Lu-247, is not considered eligible for the National Register of Historic Places. The site's ability to provide important scientific data has been lost due to the combined effects of beach erosion and inundation. Mechanical action has removed artifacts from their original deposits, destroying the site's contextual integrity and precluding the isolation of discrete cultural or temporal associations. The water-worn condition of most of the artifacts further limits their usefulness in investigations of production technology or in functional analysis. Despite the large artifact collections from the site, the material is not unusual or of outstanding scientific value. It is believed that the site contains no data which could not be recovered more efficiently elsewhere.

As the site does not contain significant research potential and is not considered eligible for listing in the National Register, the proposed project is expected to have no effect upon significant archeological resources.

Recommendations

It is the recommendation of John Milner Associates that no additional archeological investigation of the Maumee Bay Site, 33-Lu-247, is necessary. The conclusion of the intensive site testing and evaluation reported herein is that the site is not significant nor eligible for the National Register of Historic Places. It is also believed that additional testing or other field investigation is not likely to provide data sufficient to alter this conclusion.

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1980b Cultural Continuity and Change in the Region of the Western Lake Erie Basin: The Sandusky Tradition. Paper presented at the Annual Meeting of the Ohio Academy of Science, April, 1980. Toledo, Ohio.

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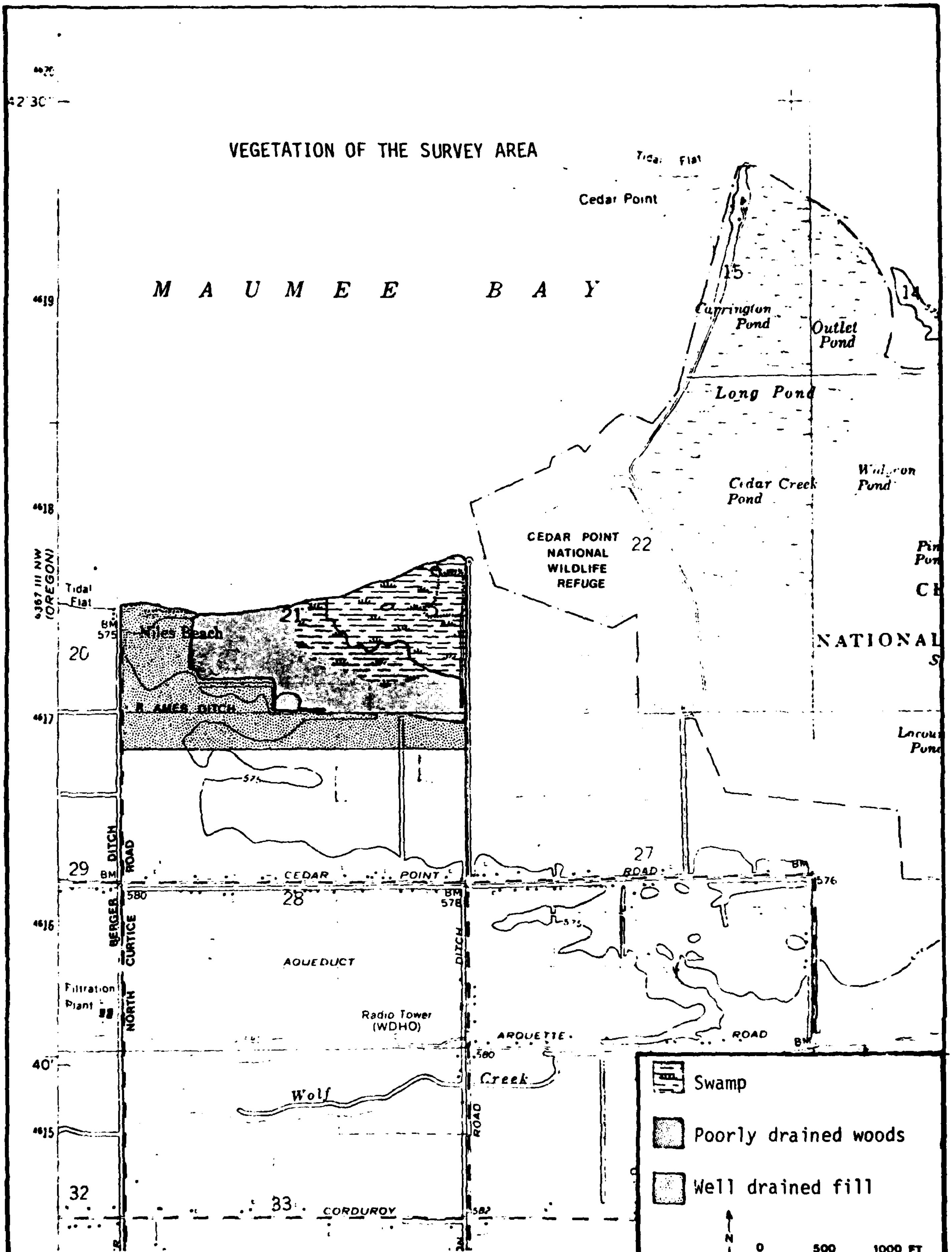
FIGURES

LOCATION OF MAUMEE BAY STATE PARK

LUCAS COUNTY, OHIO

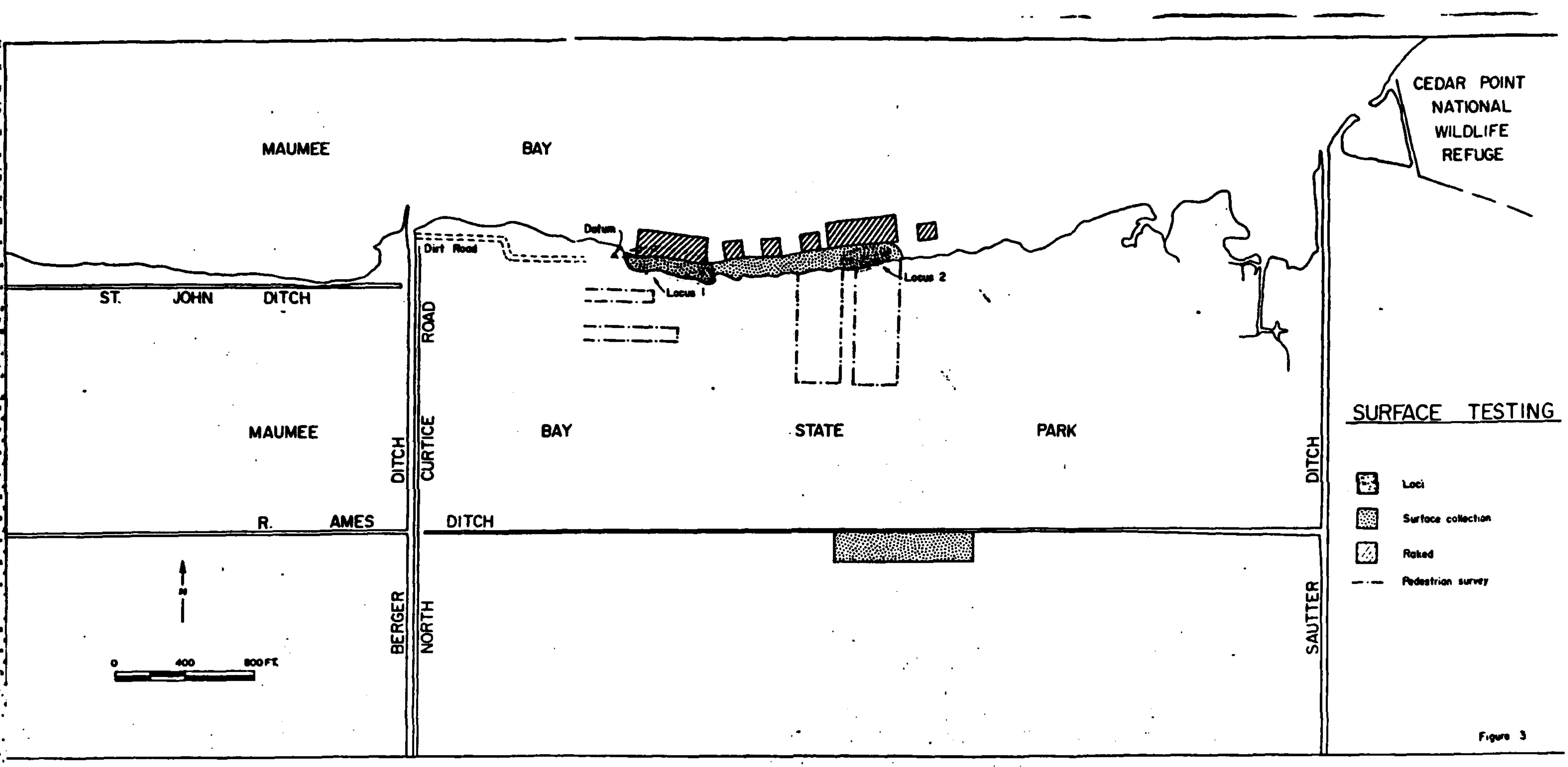
(Stone, et. al. 1980:viii)

Figure 1

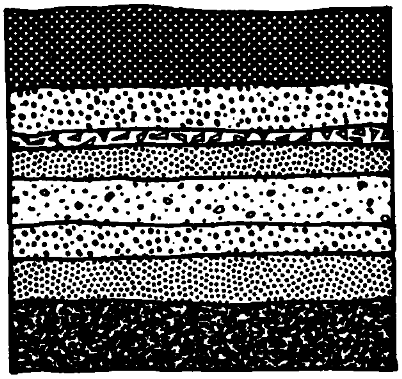


(U.S.G.S. 7.5' Series, Reno Beach, Ohio 1967)
(Stone, et. al. 1980:Plate 14)

Figure 2


CEDAR POINT NATIONAL WILDLIFE REFUGE
MAUMEE
BAY
Datum
Dirt Road
Locus 1
Locus 2
ST. JOHN DITCH
ROAD
CURTICE
DITCH
MAUMEE
BAY
STATE
PARK
R. AMES
DITCH
BERGER
NORTH
DITCH
SAUTTER
SURFACE TESTING
Loci
Surface collection
Raked
Pedestrian survey
0
400
800 FT.
N
Figure 3

PROFILE , UNIT I



Dark greyish brown sandy clay with gravel and asphalt (10 YR 4/2)

Dark brown sandy clay and gravel (10 YR 3/3)

Decayed rock (10 YR 7/2)

Dark yellowish brown sand (10 YR 4/4)

White sand and gravel

Dark brown sandy clay and gravel (10 YR 3/3)

Dark yellowish brown sand (10 YR 4/4)

Black ash and cinder

0 6 12 in.

Figure 5

PROFILES , LOCUS I

UNITS 4,7, AND 10

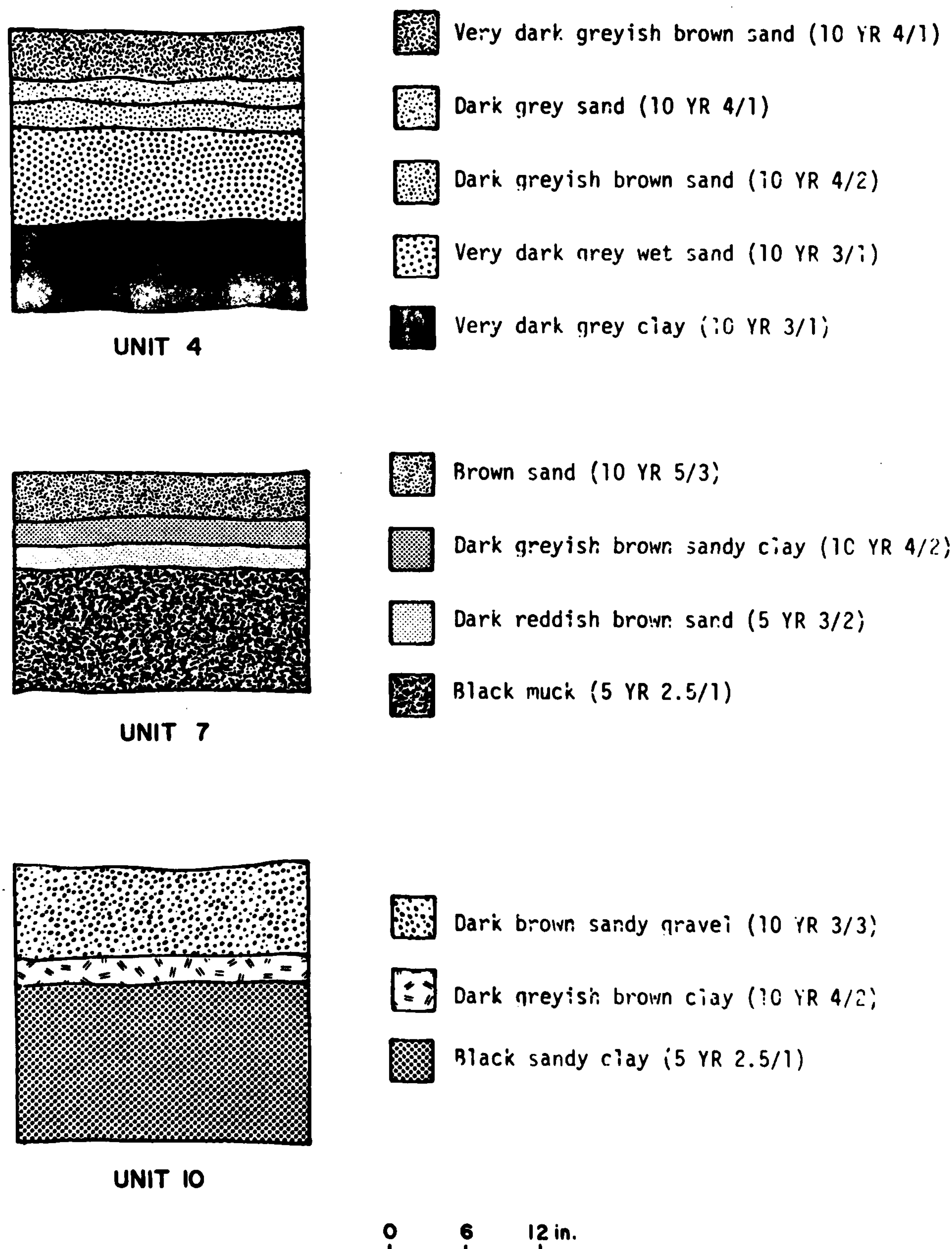
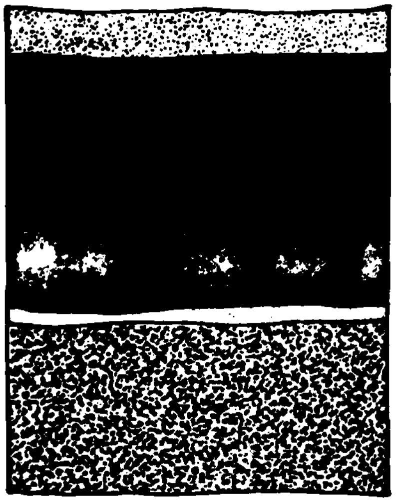


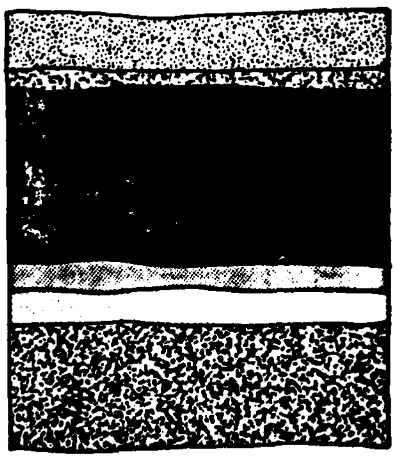
Figure 6

PROFILES , LOCUS I
UNITS 32 AND 33



UNIT 32

- Brown sand (10 YR 4/3)
- Very dark greyish brown clay (10 YR 3/2)
- Dark reddish brown sand (5 YR 3/2)
- Black muck (10 YR 2.5/1)



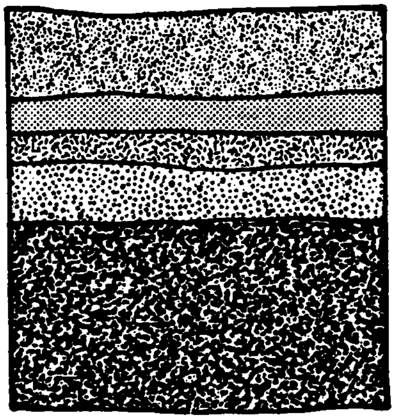
UNIT 33

- Brown sand (10 YR 4/3)
- Black sandy leaf mould (5 YR 2.5/1)
- Very dark greyish brown clay (10 YR 3/2)
- Brown clay (10 YR 4/3)
- Dark reddish brown sand (5 YR 3/2)
- Black muck (10 YR 2.5/1)

0 6 12 in.

Figure 7

PROFILE , UNIT 12



Brown sand (10 YR 5/3)

Dark grey sandy clay (10 YR 4/1)

Very dark greyish brown sandy clay (10 YR 3/2)

Dark brown sand (10 YR 3/3)

Black muck (5 YR 2.5/1)

0 6 12 in.

Figure 8

PROFILES , LOCUS 2

UNITS 5,6, AND 29

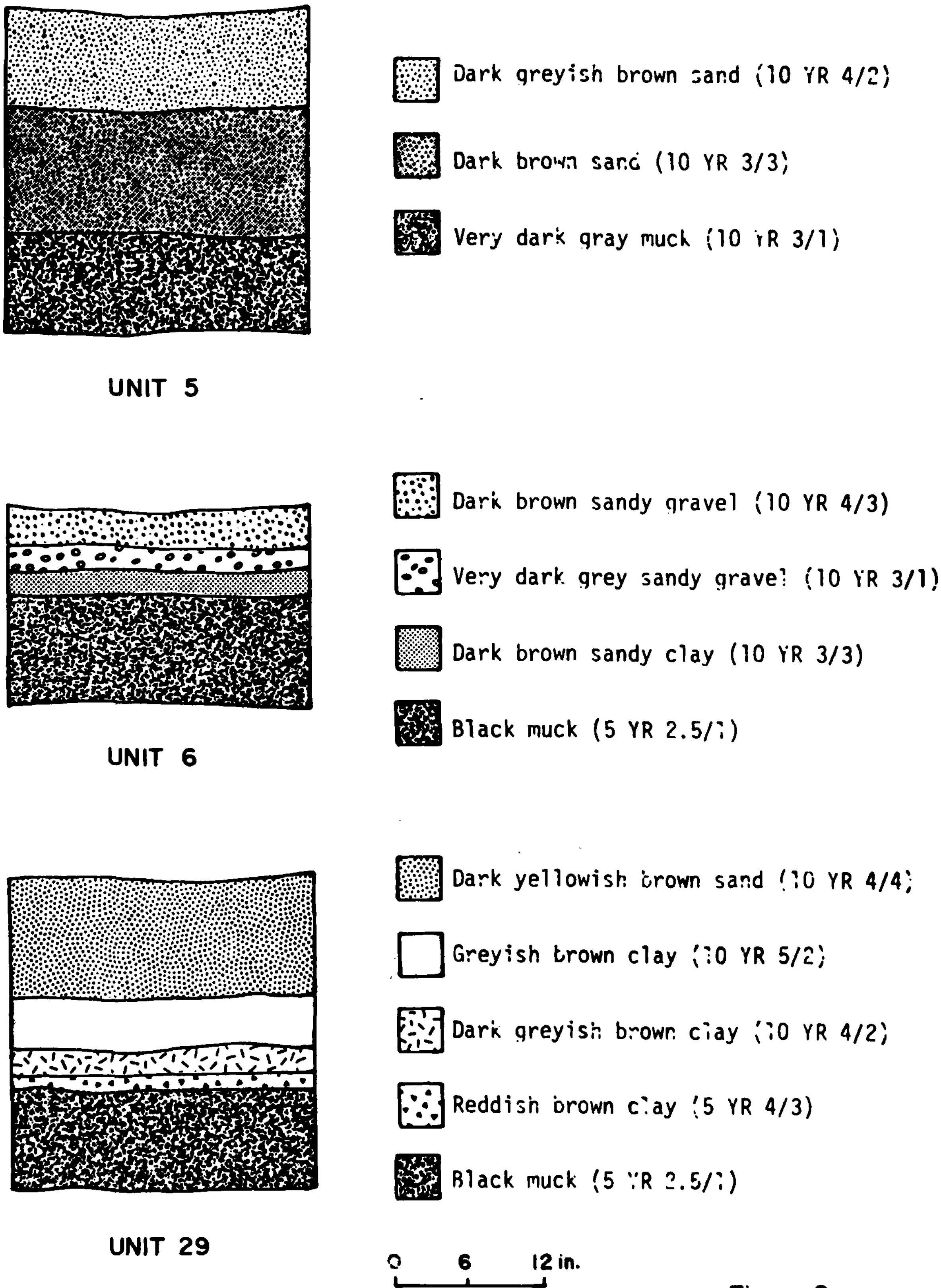


Figure 9

PROFILES , UNITS 20 AND 22

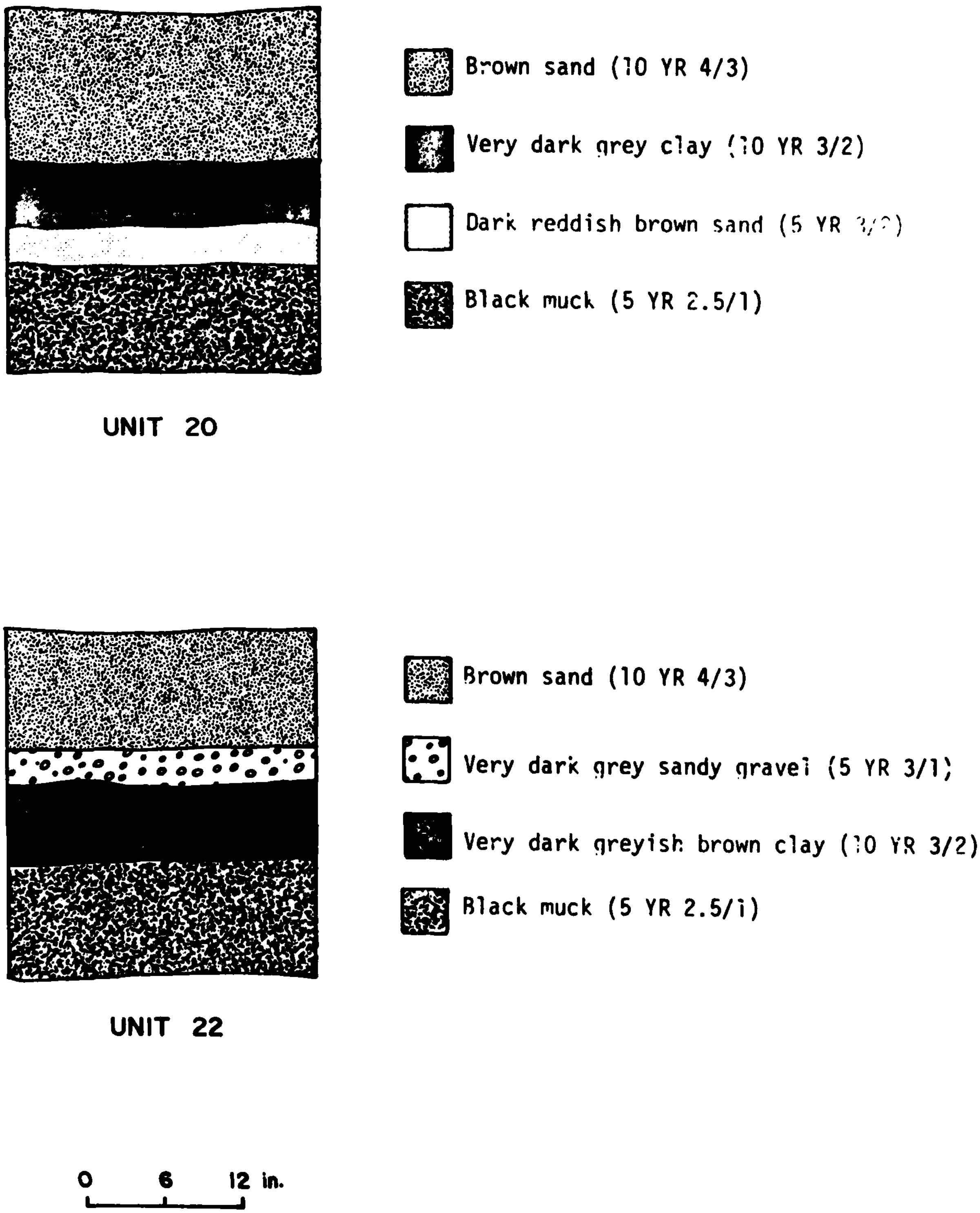


Figure 10

PLATES

Plate 1

Plate 2

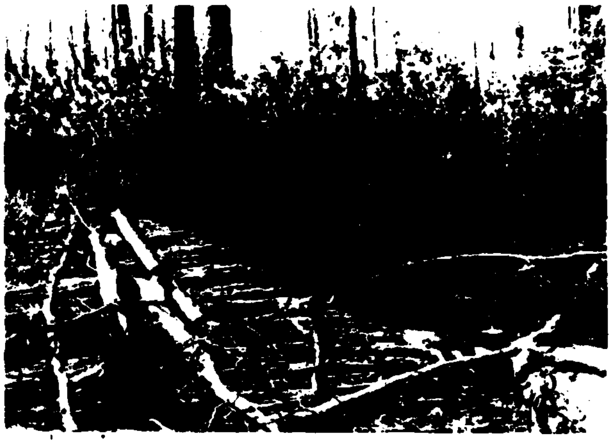


Plate 1 Revetment from North Curtice Road to Locus 1.

Plate 2 Barge at Locus 2.

Plate 3

Plate 4

Plate 3 General view of Locus 1.

Plate 4 General view of Locus 2.

Plate 5

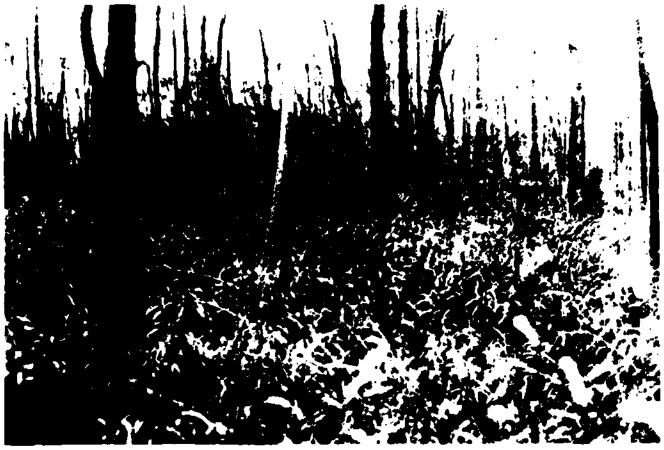


Plate 6

Plate 5 Poorly drained woods at Locus 1.

Plate 6 Poorly drained woods at Locus 2.

Plate 7

Plate 8

Plate 7 Low water at Locus 1.

Plate 8 Low water at Locus 2.

Plate 9

Plate 10

Plate 9 Surface collection at Paulsen property.

Plate 10 Typical Test Unit.

Plate 11

Plate 12

Plate 11 Modified clam rake.

Plate 12 Power auger.

Plate 13

Plate 14

Plate 13 Paulsen collection, projectile points.

Plate 14 Paulsen collection, projectile points.

Plate 15

Plate 16

Plate 15 Paulsen collection, ground stone and pottery.

Plate 16 Paulsen collection, scrapers.

Plate 17

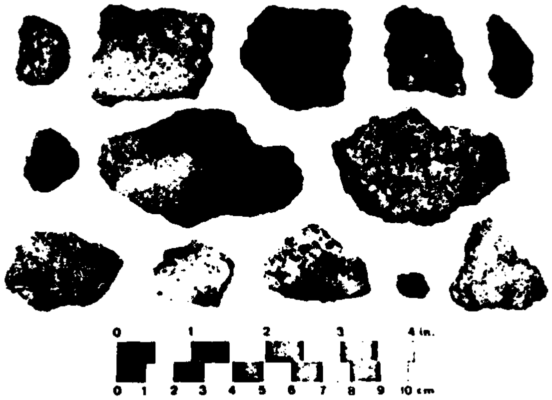


Plate 18

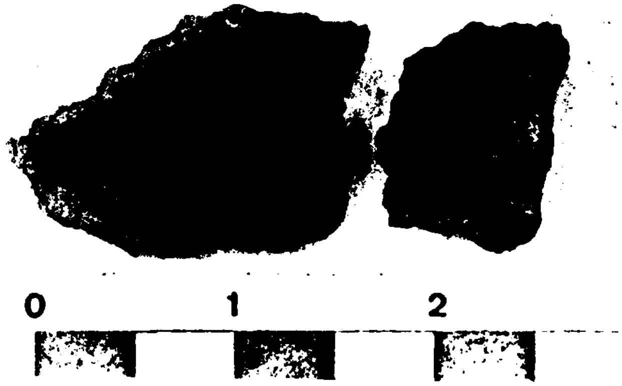


Plate 17 Pottery, Feature 1, Locus 1.

Plate 18 Pottery, Unit 19.

Plate 19

Plate 20

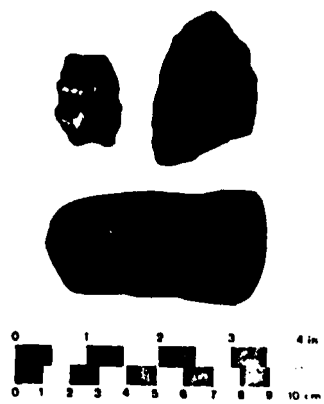


Plate 19 Lithic artifacts, Locus 1.

Plate 20 Lithic artifacts, Locus 2.

APPENDIX IV
VITAE

VITA

ROBERT F. HOFFMAN

EDUCATION

B. A.	Long Island University	Political Science	1971
Graduate Courses	University of Nice, France	Economics	1972

EMPLOYMENT HISTORY

1973-1977 — Research Associate, Section of Archeology, Division of Historical and Cultural Affairs, State of Delaware

1977 — Excavation Crew Chief, Mid-Atlantic Archeological Research, Newark, Delaware

1977-1980 — Survey Archeologist, Volunteer, Maine State Historic Preservation Committee

1980-present — Project Manager, Field Supervisor, Mid-Atlantic Archeological Research, Newark, Delaware and John Milner Associates, West Chester, Pennsylvania

PROFESSIONAL AFFILIATIONS

Society for American Archaeology
Archaeological Society of Delaware
Eastern States Archeological Federation
Maine State Historic Preservation Committee

REPORTS AND PUBLICATIONS

1976 — The Taylor Cedar Creek Site, 75-C-17 (co-author).
1980 — U. S. Coast Guard Station at Horn Point (co-author).

VITA

THOMAS L. STRUTHERS

EDUCATION

B.A.	Drew University	Anthropology	1973
M.A.	Idaho State University	Anthropology	1976

EMPLOYMENT HISTORY

1972-1973	Museum Academic Assistant, Deparment of Anthropology, Drew University
1975	Cultural Resource Management Intern, Department of Anthropology, Idaho State University
1976	Acting Assistant Curator of Archeology Idaho State University Museum of Natural History, Pocatello, Idaho
1977-1979	Forest Archeologist, Payette National Forest, McCall, Idaho
1979-present	Archeologist, John Milner Associates West Chester, Pennsylvania

PROFESSIONAL AFFILIATIONS

Society for American Archaeology
Society for Historical Archaeology
American Society for Conservation Archeology
Plains Anthropological Conference

REPORTS AND PUBLICATIONS

1975	Final Report on Archeological and Historical Resources of the Bureau of Reclamation's Upper Snake River Project, Twin Falls and Cassia Counties, Idaho. Pocatello: Archaeological Reports No. 1, The Idaho State University Musuem of Natural History.
1977-1979	Over thirty Cultural Resource Inventory Reports for Environmental Analysis Reports of Forest Service development projects.
1979	Archeological Excavations at Site 18-FR-320, Catoctin, Maryland: An Interim Report (co-author).
1980	Archeological Reconnaissance of the Berks County Heritage Center, Berks County, Pennsylvania.
1980	Cultural Resource Survey Route 24, Morristown, New Jersey (co-author).
1981	Archeological Survey of Catoctin Furnace, Cunningham Falls State Park and Adjacent Areas, Frederick County, Maryland.

VITA
DANIEL G. ROBERTS

EDUCATION

B.A.	Beloit College	Anthropology	1969
M.A.	Idaho State University	Anthropology	1976

EMPLOYMENT HISTORY

1973	Archeological Field Director, Pennsylvania Historical and Museum Commission
1974-1975	Research Assistant, Department of Anthropology, Idaho State University
1976-1978	Staff Archeologist, John Milner Associates, West Chester, Pa.
1979-present	Senior Archeologist, John Milner Associates, West Chester, Pa.

TEACHING EXPERIENCE

Guest lecturer at Temple University and the University of Pennsylvania.

PROFESSIONAL AFFILIATIONS

Membership in twelve national, regional, or state archeological societies.

PROJECT MANAGEMENT

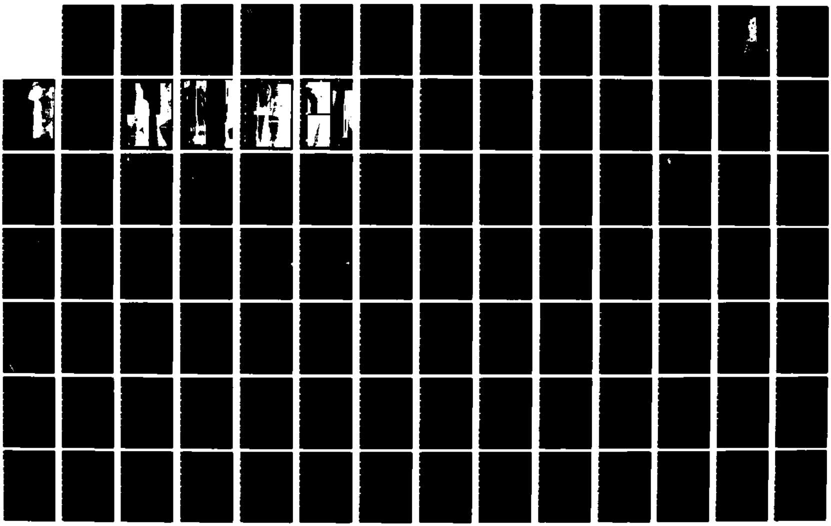
Over two dozen cultural resource projects pertaining to prehistoric and historic archeological resources and the built historical environment.

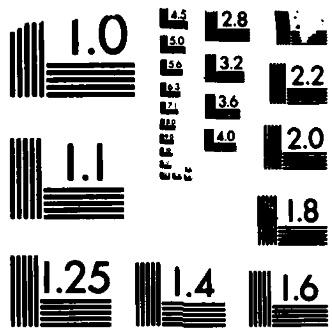
REPORTS AND PUBLICATIONS

Over two dozen cultural resource management reports for federal, state, local, and private sponsors. Four publications in monograph series and state or national journals.

AD-A138 420 MAUMEE BAY STATE PARK OHIO SHORELINE EROSION BEACH RESTORATION STUDY FINA..(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT DEC 83 5/6

UNCLASSIFIED F/G 13/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

VITA
KENNETH M. JOIRE

EDUCATION

B.A.	Franklin Pierce College	Anthropology	1981

EMPLOYMENT HISTORY

1974-1976	Volunteer Archeologist, Ridley Creek State Park, Edgemont, Pennsylvania.
1977	Archeologist, City of Alexandria, Alexandria, Virginia
1978	Archeologist, Division of Water Conservation and Pollution Control, State of New Hampshire, Concord, New Hampshire.
1979	Laboratory Assistant, Department of Anthropology, Franklin Pierce College, Rindge, New Hampshire.
1980-present	Archeological Technician, John Milner Associates

PROFESSIONAL AFFILIATIONS

Center for American Archeology
Northeastern Anthropological Association

PAPERS

1981	The Analogy of the Upper and Middle Delaware Valley: An Evironmental Approach through Late Holocene Populations.

APPENDIX V
LETTERS OF COMMENT

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

RECD
FEB 1 198
JOHN MILNER
ASSOCIATES

NCBSP Re: Contract No. DACW49-81-C-0060

29 January 1982

Mr. Thomas L. Struthers
John Milner Associates, Inc.
309 N. Matlak Street
West Chester, PA 19380

Dear Mr. Struthers:

Transmitted herewith for your consideration in producing the final report are comments from the National Park Service and the Buffalo District on your draft report, Archeological Testing and Evaluation of Site 33-LU-247: Maumee Bay State Park, Lucas County, Ohio, 1981. Also enclosed is a letter from the Ohio Historic Preservation Office which concurs with the findings of this report.

Under terms of the referenced contract, please submit a final report within 15 days of receipt of these comments.

If you have any questions, please contact Ms. Kathleen McDermott at (716) 876-5454, extension 2173.

Sincerely,

BRUCE I. SANDERS
Contracting Officer's Representative

3 Incl
as stated

United States Department of the Interior

NATIONAL PARK SERVICE
MIDWEST REGION
ANN ARBOR OFFICE
FEDERAL BUILDING
ANN ARBOR, MICHIGAN 48107

IN REPLY REFER TO:
January 5, 1981

H34(MWR-P)

Mr. Charles E. Gilbert
Chief, Planning Division
Buffalo District
U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Gilbert:

In response to your November 18, 1981, request, we have reviewed the draft report entitled, "Archaeological Testing and Evaluation of Site 33 - Lu - 247, Maumee Bay State Park, Lucas County, Ohio," by R. F. Hoffman and T. L. Struthers, and have the following comments:

1. The Principal Investigator for the project needs to be identified.

2. D. G. Roberts's and K. M. Joire's vitae should be included in the report.

3. "Paleoindian" (pages 6, 7, etc.) is usually written with a hyphen. Indian should be capitalized.

In general, the report is comprehensive and serves as a useful planning tool. Thank you for giving us the opportunity to comment on this project. If you have any questions, please write or call Jerry Fairchild, Archeologist, at (402) 221-3371 or FTS 864-3371.

Sincerely,

Charles E Carlson

for David H. Shonk
Chief, Ann Arbor Office

Incl 1

Sheet 1 of

BUFFALO DISTRICT

Branch/Office Environmental Reviewer Daly/McDermott Ext. No. 2173

"Archeological Testing and Evaluation of Site
Subject: 33-Lu-247" Maumee Bay State Park, Ohio Date 26 Jan 1982

CMT. NO.	Dwg. or Para. No.	COMMENT
1	Fig. 2	Make road names evident on the Figure so it can readily be compared with Figure 3.
2	p.15 para.2	Substitute southwest for southeast
3	p.15 para.3	Move the reference to Plate 10 up one sentence. Otherwise one expects to see a photograph of shovels.
4.	p.20 para. 1 sen. 8	Insert the word "the" between "the bulk of" and "testing was conducted."

Incl 2

Ohio Historic Preservation Office
Ohio Historical Center I-71 & 17th Avenue Columbus, Ohio 43211 (614) 466-1500

December 18, 1981

Charles E. Gilbert, Chief
Planning Division
Buffalo District, Corps. of Engineers
1776 Niagara Street
Buffalo, New York 14207

Re: Archaeological Survey Report
Maumee Bay State Park
Lucas County, Ohio

Dear Mr. Gilbert:

This is in reply to your letter of November 18, 1981, transmitting the above survey report for our review and comment.

The staff of the Ohio Historic Preservation Office has reviewed the report and we are in concurrence with the findings and recommendations of the archaeologists. In my opinion the Maumee Bay Site (33 LU 247) is not eligible for inclusion in the National Register of Historic Places and no further work is recommended. You may proceed with your shoreline erosion and flood protection project at this location with no effect on cultural resources.

A copy of the report will be placed in the permanent record file at the Ohio Historical Center to aid future researchers studying Lucas County, Ohio. Thank you for your time and consideration in protecting Ohio's archaeological record.

Sincerely,

W. Ray Luce

W. Ray Luce
State Historic Preservation Officer

WRL/BD:vb

Incl 3

APPENDIX I
WETLAND FIELD REPORT
AND
ENVIRONMENTAL

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

NCBPD-ER 3 November 1981

MEMORANDUM FOR RECORD

SUBJECT: Maumee Bay State Park Wetland Field Inspection

1. Introduction.

a. This report summarizes the field observations of 19-21 October 1981 concerning the occurrence of freshwater wetlands at Maumee Bay State Park. Comparison of Master Plans for the park with p. A-5 of the Buffalo District's September 1980 Maumee Bay State Park Preliminary Feasibility Report indicated the potential construction of a lodge complex in a freshwater wetland (Incl 1 and 2). The purpose of this investigation was to delineate the limits of the existing wetland and determine whether the wetland boundaries fell within the area proposed for park development. The location of the proposed revetment and the need for a break or other openings in the revetment were also considered during this investigation.

b. I was accompanied on 20 October 1981 by Mr. Michael Colvin of the Ohio Department of Natural Resources (ODNR), Ms. Diana Hwang of the Columbus Field Office of the U.S. Fish and Wildlife Service (USF&WS), Mr. Richard Mammoser of the Buffalo District's Western Basin, and Ms. Joan Pope of the Buffalo District's Coastal Engineering Section. Mr. Mammoser also accompanied me on 21 October.

2. Existing Environmental Conditions.

a. The subject field inspection was performed by walking selected areas between the Niles Point vicinity and the Cedar Point National Wildlife Refuge. A vegetative covertype map was later constructed using 23 June 1978 aerial photographs, the Reno Beach, OH topographic quandrangle, and data collected from the field. Copies of the 23 June 1978 aerial photographs are included as Incl 3. Ground level photographs taken during the inspection are attached as Incl 4.

b. A map of covertypes existing at the time of inspection is attached as Incl 5. Nomenclature for wetland covertypes generally followed that contained in Classification of Freshwater Wetlands in the Glaciated Northeast, by Golet and Larsen. Plant keys used in preparing the covertype map included a Field Guide to Wildflowers of Northern and Northcentral America by Peterson and McKenny, A Field Guide to Trees and Shrubs by Petrides, A Manual of Aquatic Plants by Fassett, and Fruit and Twig Key to Trees and Shrubs by Harlow.

NCBPD-ER
SUBJECT: Maumee Bay State Park Wetland Field Inspection

3. Discussion.

a. A prevalence of aquatic vegetation was noted in covertype areas which are heavily stippled on Incl 5. The ditch which occupied a portion of covertype Area 17 was also colonized with a prevalence of aquatic vegetation (*Typha* sp.).

b. Corps Regulations 33 CFR 323.2(c) define wetlands as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Based on the observations made in the field, the heavily stippled areas on Incl 5 and portions of Area 17 constitute freshwater wetlands as defined by Corps regulations.

c. Comparison of Incl 5 with the Maumee Bay State Park Master Plan indicates that portions of the proposed lodge complex are located in Anderson Ditch and areas of robust marsh located adjacent to Lake Erie. The term "adjacent" as defined by Corps Regulations 33 CFR 323.2(d) mean "bordering, contiguous, or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes, and the like are adjacent wetlands." Portions of the interpretive center shown on the Park Master Plan also lie within freshwater wetlands which are located adjacent to Lake Erie as defined by Corps regulations. The proposed golf course borders the Maumee Bay State Park wetlands and may also require some associated wetland fills.

d. During the subject field inspection, I advised Mr. Colvin that a Department of the Army permit may be required for the placement of fill in park wetlands by the ODNR. Mr. Colvin stated that the Master Plan was not a final decision regarding future park development. Plans for the location and design of the lodge complex, interpretive center, and associated developments have not been finalized. Mr. Colvin requested a copy of the Corps final wetland covertype map for the eastern end of the park and stated that the ODNR would consider the location of freshwater wetlands during future planning for park development.

e. Mr. Mammoser, Mr. Colvin, and Ms. Hwang discussed the general status of the Corps study and the location of the dike for shore protection. Ms. Hwang felt that the proposed dike should perhaps be moved lakeward and that the gap in the dike should be located in the vicinity of the existing marsh for improved fish access to this area. Mr. Mammoser felt that the Corps could consider the USF&WS concerns, but that the project drawings did not require revision for the Draft Feasibility Report. Mr. Mammoser mentioned that the main benefits of the Corps project are associated with the beach at the western end of the park. The proposed golf course was, however, considered in evaluating the total project benefits.

NCBPD-ER
SUBJECT: Maumee Bay State Park Wetland Field Inspection

4. Conclusion/Recommendations.

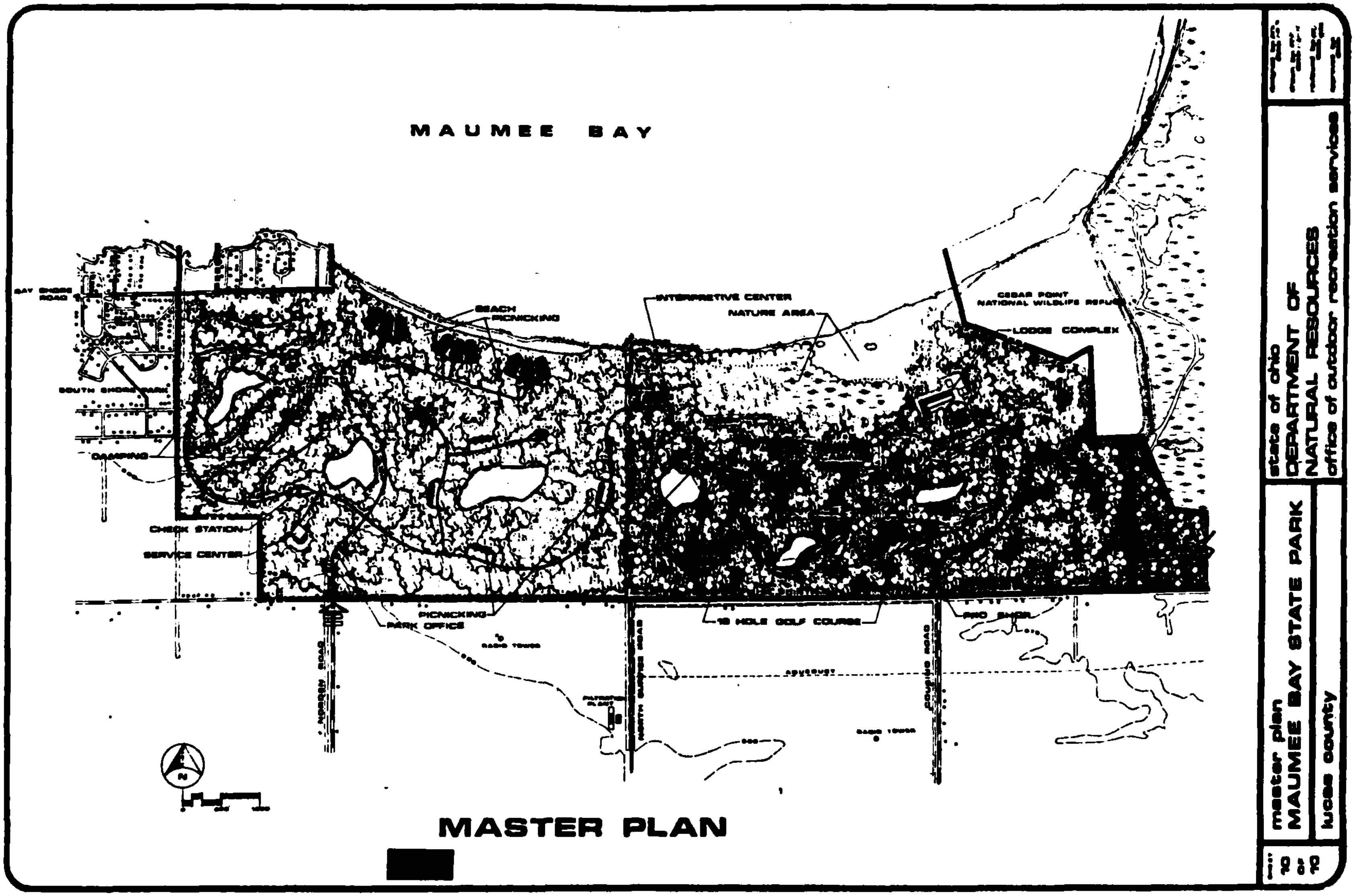
a. Portions of the proposed lodge complex and interpretive center as delineated on the Park Master Plan lie within freshwater wetlands as defined by Corps regulations. These wetlands are located adjacent to Lake Erie, which is a navigable water of the United States. Placement of fill and/or dredged material into freshwater wetlands at the proposed lodge and interpretive center sites is subject to Corps regulatory authority under Section 404 of the Clean Water Act.

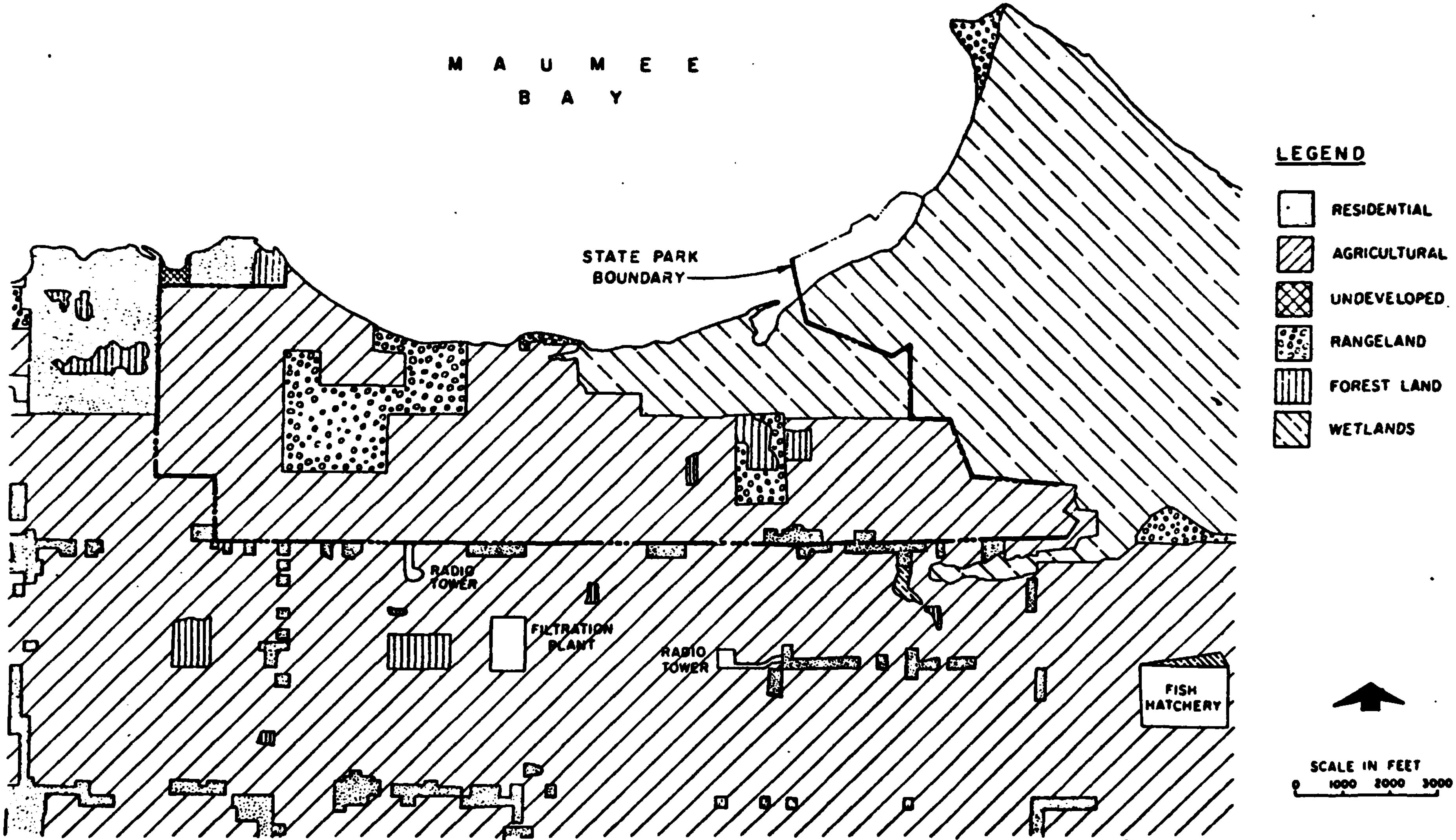
b. I recommend that a copy of this report be forwarded to the Chief of the Buffalo District's Regulatory Functions Branch. Although plans for park development are only conceptual at this time, I recommend that the Regulatory Functions Branch notify the ODNR in writing of the potential need for a Department of the Army (DA) permit for placement of fill in the Maumee Bay State Park wetlands. The letter should also state that the Buffalo District can make no guarantee that a DA permit would ultimately be issued for the wetland filling. I also recommend that a copy of the wetland covertype map be forwarded to the ODNR to assist them in future park planning and development.

David W. Heicher

5 Incl
as

DAVID W. HEICHER
Biologist, Environmental Resources Branch

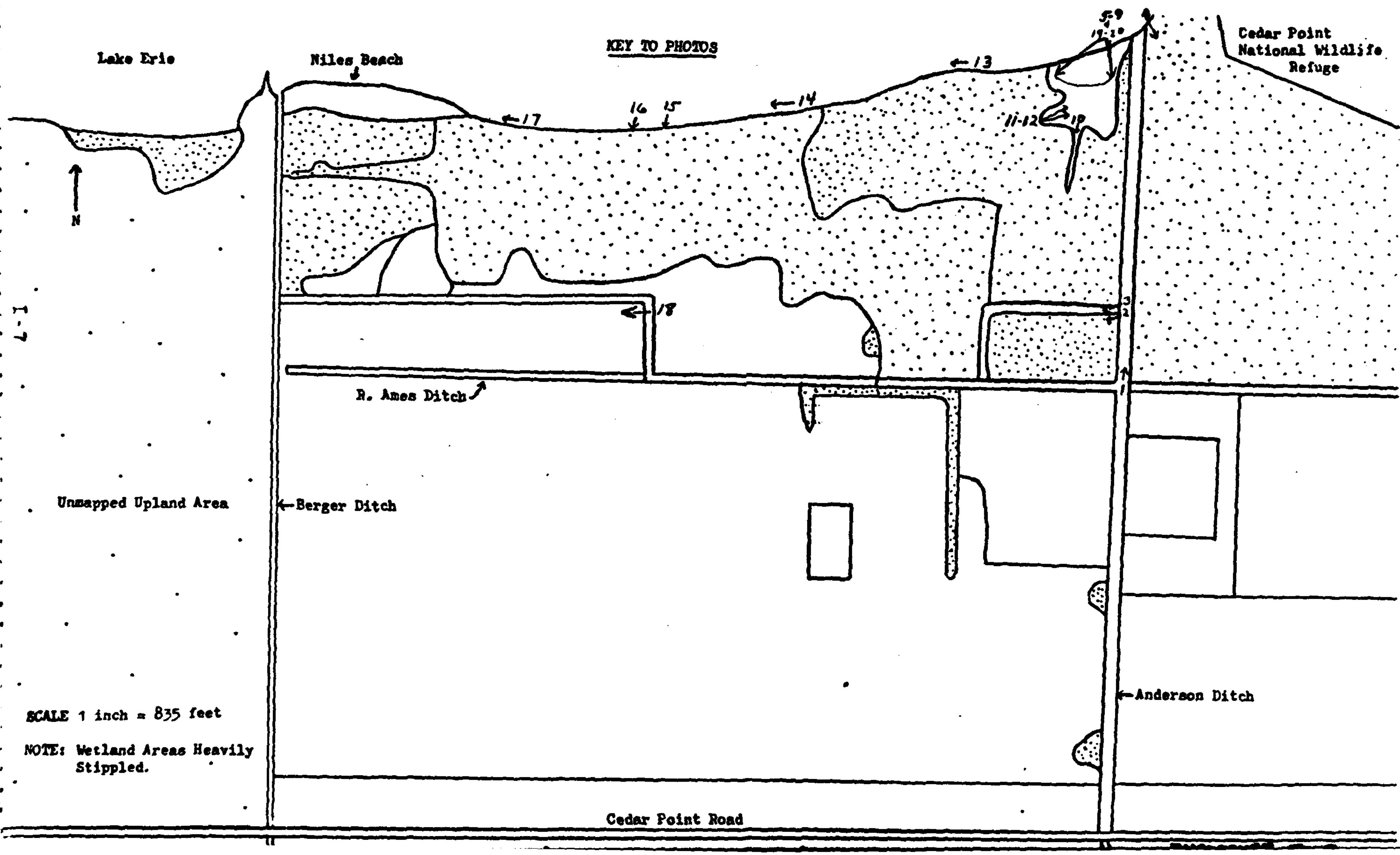

MAUMEE BAY
BAY SHORE ROAD
SOUTH SHORE PARK
CAMPING
CHECK STATION
SERVICE CENTER
BEACH
PICNICKING
PICNICKING
PARK OFFICE
RADIO TOWER
NORDEN ROAD
NORTH CURTICE ROAD
COUPLING ROAD
INTERPRETIVE CENTER
NATURE AREA
18 HOLE GOLF COURSE
CEDAR POINT NATIONAL WILDLIFE REFUGE
LODGE COMPLEX
PRO SHOP
RADIO TOWER
MASTER PLAN
state of ohio
DEPARTMENT OF NATURAL RESOURCES
office of outdoor recreation services
master plan
MAUMEE BAY STATE PARK
lucas county



LAND USE MAP
AS OF 1977/1978

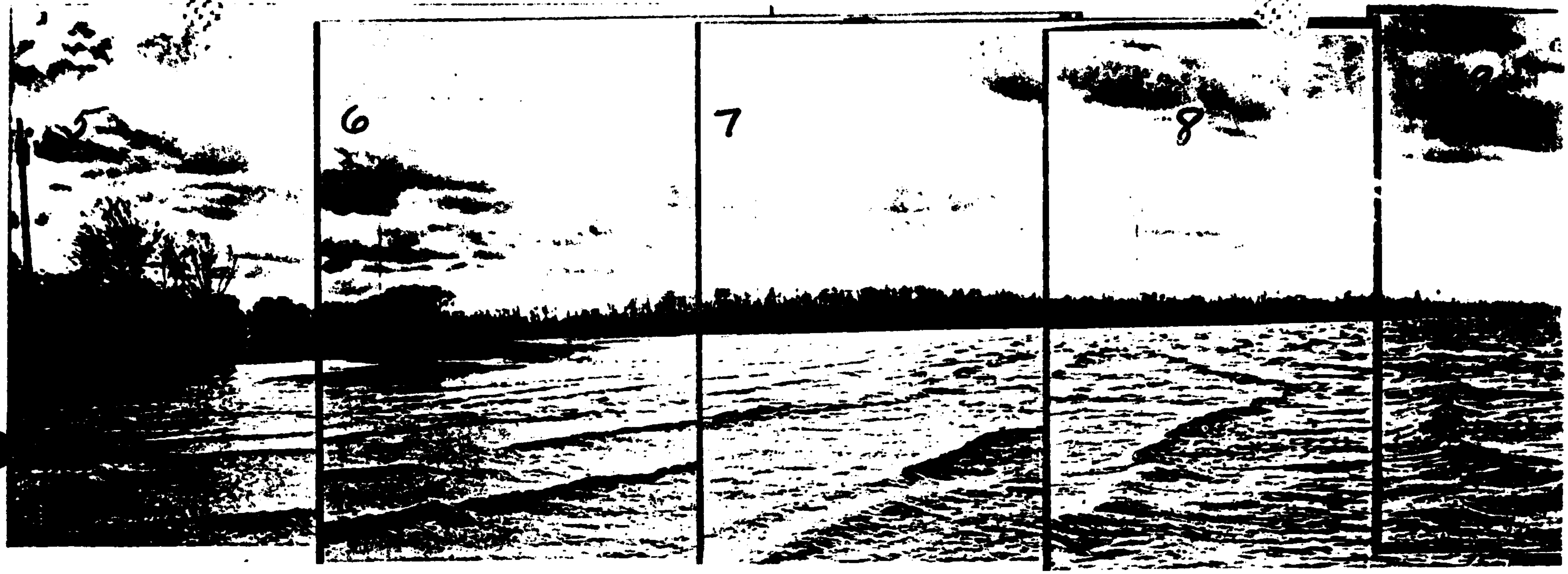
PLATE A-1


OH 2420
6-23-78
1:4800
OH 2397
6-23-78
6-23-78
OH 2394
6-23-78

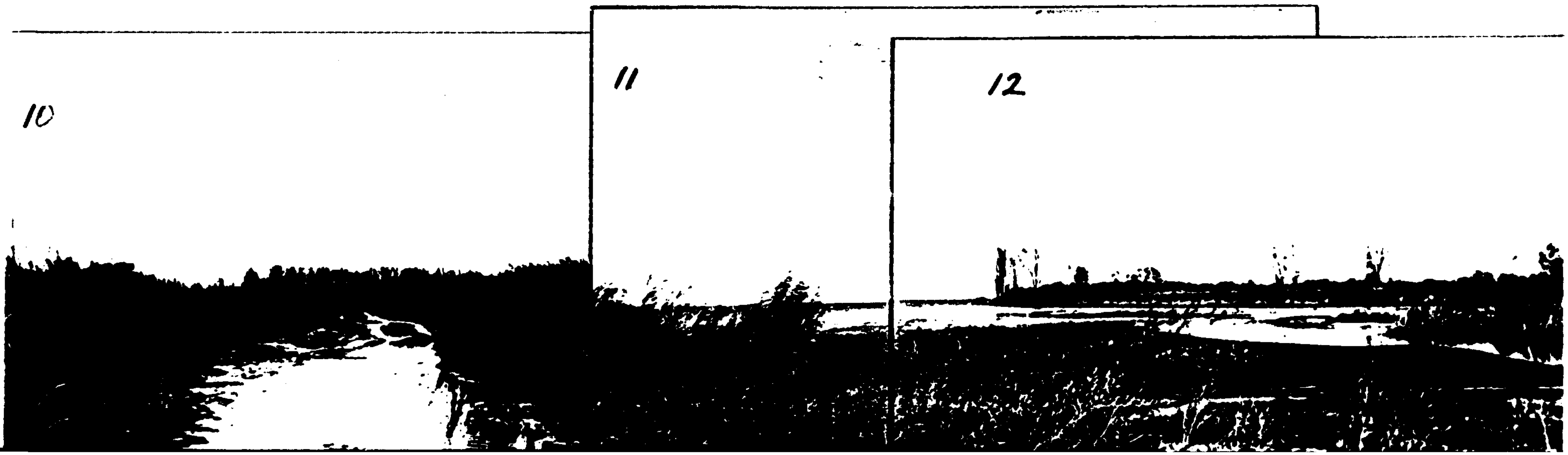


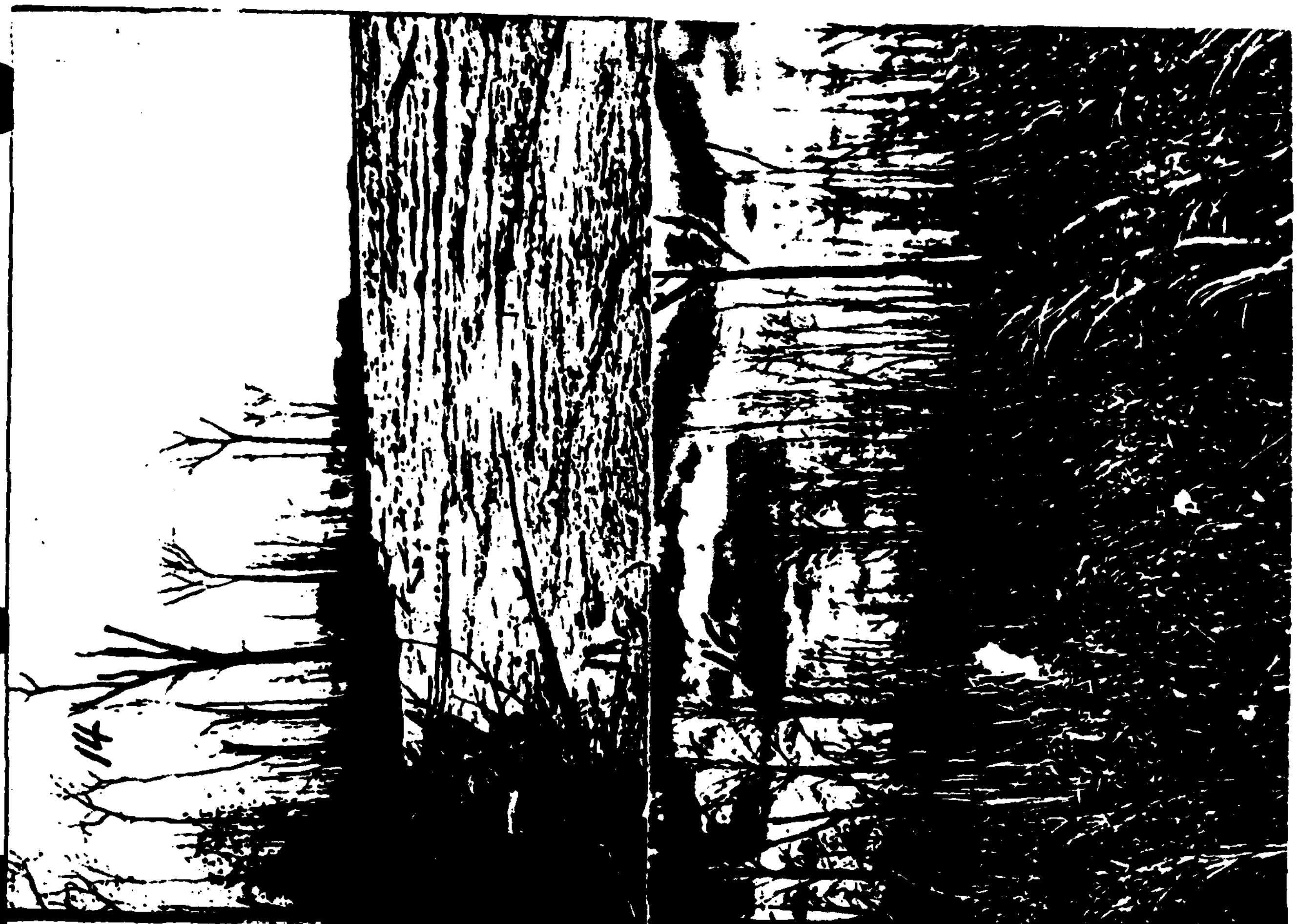
KEY TO PHOTOS
Lake Erie
Niles Beach
Cedar Point National Wildlife Refuge
N
Unmapped Upland Area
Berger Ditch
R. Ames Ditch
Anderson Ditch
Cedar Point Road
SCALE 1 inch = 835 feet
NOTE: Wetland Areas Heavily Stippled.


1
2
3
4

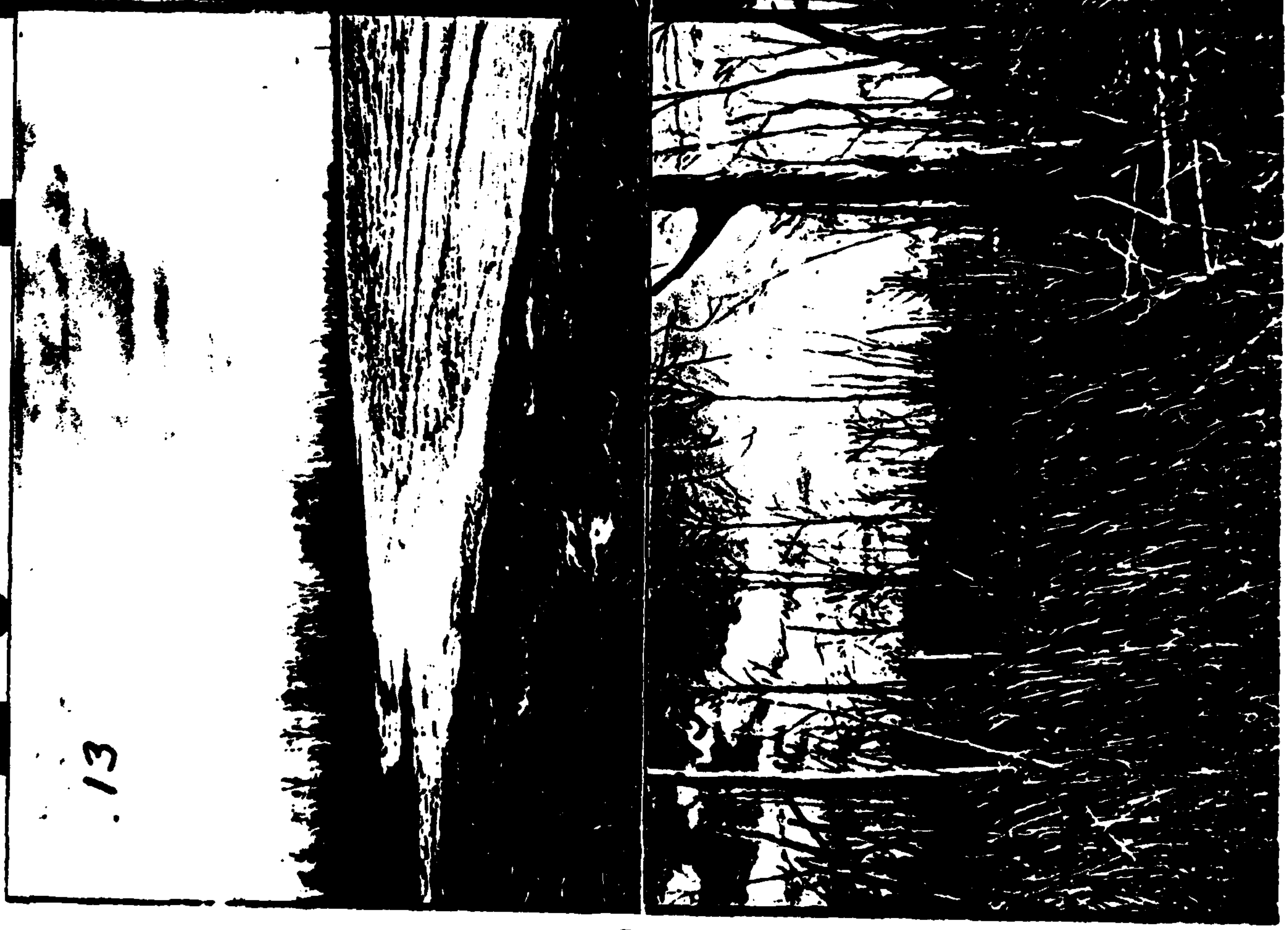


INCLOSURE FOUR (CONT.)





14

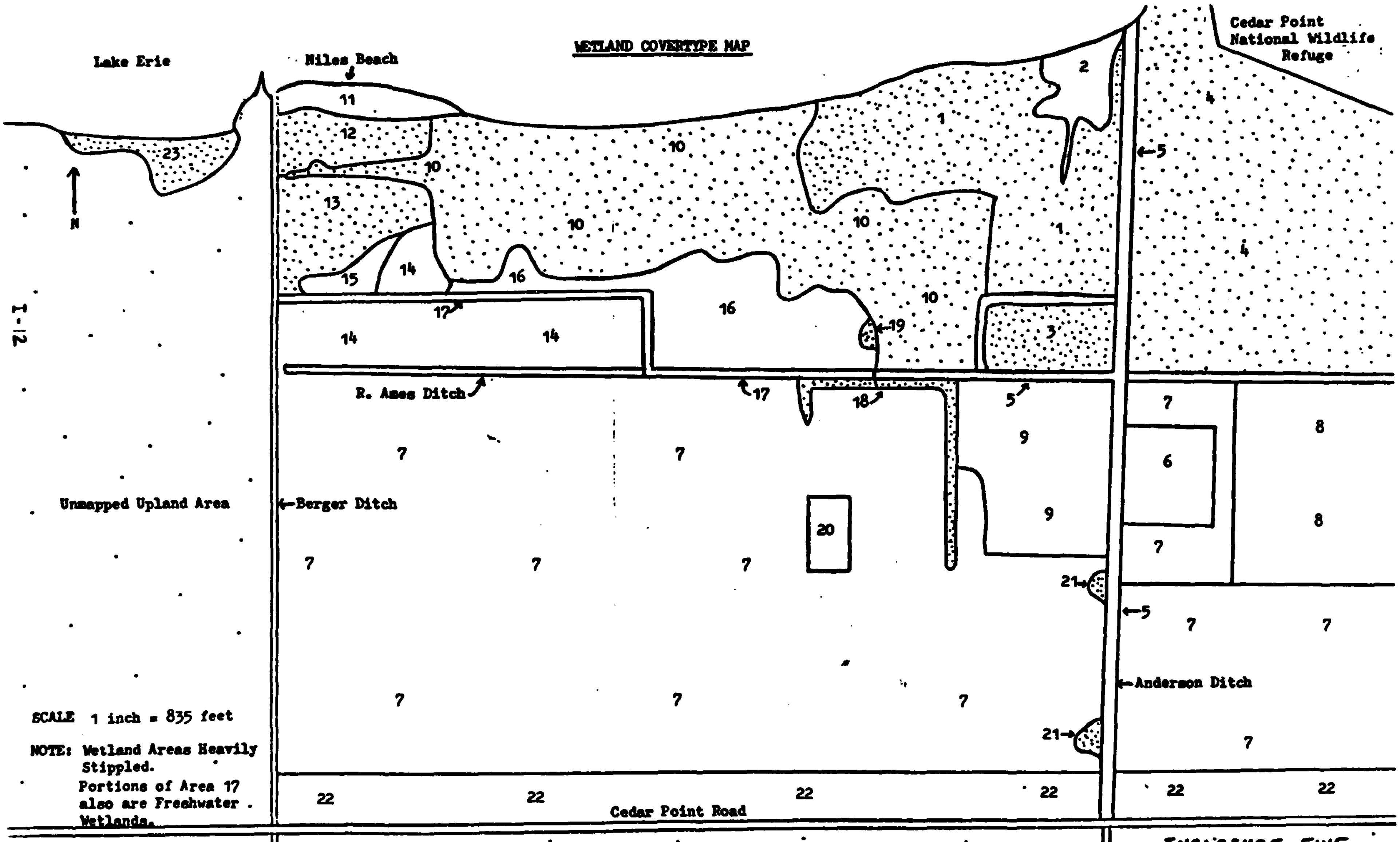


13

INCLOSURE

I-11

WETLAND COVERTYPE MAP



SCALE 1 inch = 835 feet

NOTE: Wetland Areas Heavily Stippled.
Portions of Area 17 also are Freshwater Wetlands.

INCLOSURE FIVE

Key to Vegetative Covertypes

Area	Existing Covertype
1*	Robust Marsh colonized primarily with cattail (Typha sp.), mixed with patches of river bulrush (Scirpus fluviatilis), softstem bulrush (Scirpus validus), smartweeds (Polygonum spp.), bur reed (Sparganium sp.), purple loostrife (Lythrum salicaria), Joe-pye-weed (Eupatorium sp.), reed (Phragmites sp.), swamp rose mallow (Hibiscus palustris), wild millet (Enchinochloa sp.), and duckweed (Lemna minor). Water levels variable due to Lake Erie seiches.
2	Unvegetated flat.
3*	Robust marsh dominated by cattail (Typha sp.), with some river bulrush (Scirpus fluviatilis), blue vervain (Verbena hastata), and purple loostrife (Lythrum salicaria).
4*	Robust marsh colonized primarily with cattail (Typha sp.). The marsh contains areas of open water and several d'kes which are colonized with short, unidentified grass species (Gramineae) and the species listed for Area 5 below.
5	Drainage ditches bordered by dikes colonized with staghorn sumac (Rhus typhina), red ozier dogwood (Cornus stolonifera), cottonwood (Populus deltoides), grape (Vitis sp.), willow (Salix sp.), red-panicle dogwood (Cornus racemosa), elderberry (Sambucus canadensis), goldenrod (Solidago sp.), wild carrot (Daucus carota), white sweet clover (Melilotus alba), teasel (Dipsacus sp.), asters (Aster spp.), jewelweed (Impatiens sp.), rose (Rosa sp.), and wild cucumber (Echinocystis lobata).
6	Deciduous bottomland forest consisting of cottonwood (Populus deltoides), red maple (Acer rubrum), silver maple (Acer saccharinum), grape (Vitis sp.), flowering dogwood (Cornus florida), silky dogwood (Cornus amomum), American elm (Ulmus americana), swamp white oak (Quercus bicolor), hickory (Carya sp.), and hawthorn (Crataegus sp.).
7	Cultivated field.
8	Old field colonized with wild carrot (Daucus carota), goldenrod (Solidago sp.), and asters (Aster sp.).
9	Deciduous bottomland forest colonized with sycamore (Platanus occidentalis), red maple (Acer rubrum), swamp white oak (Quercus bicolor), red ozier dogwood (Cornus stolonifera), silky dogwood (Cornus amomum), grape (Vitis sp.), rose (Rosa sp.), asters (Aster spp.), goldenrod (Solidago sp.), elderberry (Sambucus canadensis), American elm (Ulmus americana), unidentified thistle (Cirsium sp?), red oak (Quercus rubra), unidentified grasses (Gramineae), and green ash (Fraxinus pennsylvanica var. subintegerrima).

Key to Vegetative Covertype (Cont'd)

Area	Existing Covertype
10*	Deciduous wooded swamp vegetated with red maple (Acer rubrum), American elm (Ulmus americana), willow (Salix sp.), box elder (Acer negundo), cottonwood (Populus deltoides), green ash (Fraxinus pennsylvanica var. subintegerrima), red ozier dogwood (Cornus stolonifera), swamp white oak (Quercus bicolor), silky dogwood (Cornus amomum), elderberry (Sambucus canadensis), cattail (Typha sp.), river bulrush (Scirpus fluviatilis), reed (Phragmites sp.), purple loostrife (Lythrum salicaria), swamp milkweed (Asclepias incarnata), bur reed (Sparganium sp.), jewelweed (Impatiens sp.), blue vervain (Verbena hastata), boneset (Eupatorium perfoliatum), rice cut-grass (Leersia oryzoides), water plaintain (Alisma sp.), beggar ticks (Bidens sp.), arrowhead (Sagittaria sp.), clearweed (Pilea pumila), water-parsnip (Sium suave), smartweeds (Polygonum spp.), water-horehound (Lycopus sp.), and Joe-pye-weed (Eupatorium sp.). Some asters (Aster spp.), wild carrot (Daucus carota), common evening primrose (Oenothera biennis), rose (Rosa sp.), blackberry (Rubus allegheniensis), and goldenrod (Solidago sp.) are scattered in areas of highest ground elevation. Soil moist, with standing, shallow water (<1-foot deep) present in several areas. At the time of the field inspection, a clay-sand barrier beach about 20 yards wide and 3 to 5 feet high separated the waters of Lake Erie from inundated areas of the wooded swamp.
11	Disturbed upland area colonized primarily with asters (Aster spp.), goldenrod (Solidago sp.), wild carrot (Daucus carota), white sweet clover (Melilotus alba), violet (viola sp.), staghorn sumac (Rhus typhina), teasel (Dipsacus sp.), grape (Vitis sp.), common evening primrose (Oenothera biennis), and unidentified grasses (Gramineae). Some purple loostrife (Lythrum salicaria), red ozier dogwood (Cornus stolonifera), and large willow (Salix sp.), cottonwood (Populus deltoides), and red maple (Acer rubrum) trees present.
12*	Emergent wetland (apparently once agricultural land) colonized with purple loostrife (Lythrum salicaria), cattail (Typha sp.), blue vervain (Verbena hastata), swamp milkweed (Asclepias incarnata), swamp rose mallow (Hibiscus palustris), river bulrush (Scirpus fluviatilis), jewelweed (Impatiens sp.), boneset (Eupatorium perfoliatum), and mint (Mentha sp.). Soil moist, with shallow water (<1-foot deep) present in several areas.
13*	Emergent wetland (apparently once agricultural land) vegetated with purple loostrife (Lythrum salicaria), sedges (Carex spp.), swamp milkweed (Asclepias incarnata), smartweeds (Polygonum spp.), cattail (Typha sp.), unidentified thistle (Cirsium sp?), avens (Geum sp.), swamp rose mallow (Hibiscus palustris), and water-horehound (Lycopus sp.). Some scattered goldenrod (Solidago sp.) plants found in areas of highest ground elevation. Soil is moist, with a few inches of surface water in the wettest areas.

Key to Vegetative Covertype (Cont'd)

Area	Existing Covertype
14	Old field colonized with goldenrod (Solidago sp.), wild carrot (Daucus carota), asters (Aster sp), unidentified thistle (Cirsium sp?), common evening primrose (Oenothera biennis), avens (Geum sp.), red clover (Trifolium pratense), and common milkweed (Asclepias syriaca).
15	Old field colonized with the species listed for Area 14 above, with willow (Salix sp.), and cottonwood (Populus deltoides) trees up to 10 feet tall.
16	Deciduous bottomland forest vegetated with red maple (Acer rubrum), American elm (Ulmus americana), green ash (Fraxinus pennsylvanica var. subintegerrima), willow (Salix sp.), red oak (Quercus rubra), cottonwood (Populus deltoides), red ozier dogwood (Cornus stolonifera), silky dogwood (Cornus amomum), box elder (Acer negundo), swamp white oak (Quercus bicolor), shagbark hickory (Carya ovata), elderberry (Sambucus canadensis), jewelweed (Impatiens sp.), clearweed (Pilea pumila), asters (Aster sp.), Virginia creeper (Parthenocissus quinquefolia), and grape (Vitis sp.).
17 (*portion)	Dike approximately 25 feet wide bordered on its south side by a shallow ditch 10-15 feet wide. The dike is colonized with unidentified grasses (Gramineae), blackbery (Rubus allegheniensis), unidentified thistle (Cirsium sp?), with scattered small willow (Salix sp.), cottonwood (Populus deltoides), and sumac (Rhus typhina) trees and grape vines (Vitis sp.). The ditch* contains water up to 6 inches deep and is colonized with cattail (Typha sp.).
18*	Ditch with standing water, colonized with cattail (Typha sp.) and small cottonwood trees (Populus deltoides).
19*	Robust marsh colonized with cattail (Typha sp.).
20	Deciduous forest (unmapped).
21*	Area with poor drainage colonized with cattail (Typha sp.).
22	Mixed agricultural-residential land.
23*	Robust marsh colonized with cattail (Typha sp.), purple loostrife (Lythrum salicaria), with patches of mint (Mentha sp.), sedges (Carex spp.), and river bulrush (Scirpus fluviatilis).

NOTE: * Denotes areas with a prevalence of vegetation typically adapted for life in saturated soil conditions.

246 N. High Street
Post Office Box 118
Columbus, Ohio 43216

Telephone (614) 466-3543
If no answer (614) 466-8686

DEPARTMENT OF HEALTH
STATE OF OHIO

JAMES A. RHODES
Governor

JOHN H. ACKERMAN, M.D., M.P.H.
Director of Health

May 19, 1980

Mr. Bill Butler
Buffalo District
Army Corps of Engineers
1776 Niagra Street
Buffalo, New York 14207

Dear Mr. Butler:

Fecal coliform beach samples were taken from June 12 through August 22, 1978 by Ohio Department of Natural Resources personnel at the proposed beach location for Maumee Bay State Park near Oregon, Ohio. Those sample results are as follows:

Sample Date	Fecal Coliform Numbers	Geometric Mean*
6/12/78	13, 66	29
6/19/78	80, 33	39
7/03/78	56, 36	41
7/10/78	180, 102	55
7/17/78	21, 10	42
7/24/78	520, 26, 38, 248, 680	73
8/01/78	37, 38, 111, 39, 21	64
8/22/78	84,TNTC *	94

* Geometric mean determined based on most recent five week samples.

* TNTC = 10,000

SPECIAL WATER BACTERIOLOGY IN OHIO BATHING AREAS

Beach	Health District	Sampling Point	Laboratory	Manager	Year
Maumee Bay St. Pk.	Lucas Co.	Proposed Beach, E+W	NWBL	Jim Brower	198C

East / West

BACTERIA COUNTS												WEATHER				WIND													
Date Collected	Fecal Coliforms/ 100 ml	~~Log~~ average	Geometric Mean	Fecal Strep/ 100 ml	Log	Geometric Mean	Total Coliform/ 100 ml	Geometric Mean	Percent of Samples 400/100ml	Number Swimmers	Number Sunbathers	Sunny	Hazy	Cloudy	Rain	Direction	Velocity	water Cloudy	Evidence of Algae	Water Clear	Wave Height	Wave Direction	Water Temperature	Abnormal Water Condition	Unusual Weather Condition Prev. Day	Pollution Sources Active - Yes	Pollution Sources Active - No	Specimen Collected By	Time Collected
5/19	L.A. 75	75								0	0			X		N	15	X			1"	N	54		Rain		X	J.B.	10:10
6/2	100 L.A.	100	87							0	0			X		SW	15	X			2"	SW	65		Storm		X	SD	9:30
6/16	210 370	290	130							0	0	X				N-NE	15	X			5"	N-NE	64		Storm		X	SD	9:30
6/30	56 190	123								0	0			X		N-NW	10	X			4"	N-NW	67				X	SD	10:30
7/14	9 15	12	80							0	0	X				S-SW	10	X			calm		73				X	SD	9:20
7/28	5 13	9	52							0	0				X	E-SE	3	X			1'	E-SE	77		Rain		X	SD	9:10
8/11	140 42	91	51							0	0			X		N-NE	3	X			2'	N-NE	76				X	SD	9:30
8/25	72 42	57	37							0	0	X				W-SW	5	X	X		6"	W-SW	70				X	SD	9:00

SPECIAL WATER BACTERIOLOGY IN OHIO BATHING AREAS

Maumee Bay St. Pk.	Lucas Co.	E & W Ends	NWBL	Jim Brower	1981
Beach	Health District	Sampling Point	Laboratory	Manager	Year

Undeveloped/proposed beach

	BACTERIA COUNTS												WEATHER				WIND													
	Date Collected	Fecal Coliforms/ 100 ml	average	Geometric Mean	Fecal Strep/ 100 ml	Log	Geometric Mean	Total Coliform/ 100 ml	Geometric Mean	Percent of Samples 400/100ml	Number Swimmers	Number Sunbathers	Sunny	Hazy	Cloudy	Rain	Direction	Velocity mph	Water Cloudy	Evidence of Algae	Water Clear	Wave Height	Wave Direction	Water Temperature	Abnormal Water Condition	Unusual Weather Condition Prev. Da	Pollution Sources Active - Yes	Pollution Sources Active - No	Specimen Collected By	Time Collected
E/W	6/8	10									0	0			X		SW	6	X			calm		68°				X	SD	9:15 AM
	6/16	390 450	420								0	0	X				SW	9	X			calm		65		Rain on 6-14		X	SD	8:50
	6/22	180 420	300	108							0	0			X	X	W-NW	15	X			1-3'	NW	71		R		X	SD	10:15
	6/29	600 440	520	160							0	0		X			SW	9	X			calm		71	very muddy			X	SD	10:15
	7/6	400 210	305	182							0	0	X				NE	8	X			1-3	NE	70	muddy			X	SD	9:00
(1)	7/20	<10 33	17	202							0	0			X		SW	5	X			calm		73				X	SD	9:00
	7/27	1600 1200	1400	258							0	0			X		NE	8	X	X		1-3	N-NE	73		R		X	SD	11:00
	8/3	50 33	41	173							–	0			X	X	calm		X	X		calm		74		light rain		X	SD	9:00
	8/10	34 34	34	100							–	0	X				SW	8	X	X		calm		74				X	SD	10:00
(1)	8/24	<10 <10	<10	32							–	0	X				NW	7	X	X		1-2'	NW	73				X	SD	9:05
	8/31	350 130	240	24							–	0				X	S-SW	5	X	X		calm		72		R		X	SD	9:15

ODH
6/77

NCBED-PE

APR 16 1981

Dear:

We are currently preparing a Draft Environmental Impact Statement on a shoreline erosion and beach restoration study at Maumee Bay State Park, Lucas County, OH. Common components of the two alternatives recommended for final design include a 5,500-foot long protective sand beach with a vegetated storm dune along the western half of the shoreline and a 5,500-foot long rubblemound revetment protecting wetlands along the eastern half of the park. Rubblemound jetties would be constructed at McHenry and Berger Ditches to prevent clogging by longshore transport of sand from the protective beach. The two structural alternatives being considered differ in the fact that one involves a beach with no protection (Alternative 2) and the other involves protecting the beach with a system of four offshore rubblemound breakwaters (Alternative 3). The recreational beach to be developed is an integral part of the total park development proposed by the Ohio Department of Natural Resources. No-Action (Alternative 1) will remain an alternative throughout the study.

In order to fully assess the relationship between the proposed project and the plans of other agencies, we would appreciate knowing whether or not the subject project would conform or conflict with the objectives and specific terms of existing or proposed land use plans, policies, and controls, if any, that your agency may have reviewed or formulated for the project area. An evaluation of master plans, zoning regulations, plans developed in response to the Clean Air Act and the Clean Water Act of 1977, or other related land use proposals of your agency, would be helpful in this respect.

A map of the Maumee Bay State Park study area is enclosed for your reference.

NCBED-PE

We would be pleased if you would reply by 8 June 1981. If any further information is required, please do not hesitate to notify Mr. William Butler of our staff at (716) 876-5454 (FTS-473-2173). Your cooperation is greatly appreciated.

Sincerely,

1 Incl
as stated

THOMAS R. BRAUN
Lt Col, Corps of Engineers
Deputy District Engineer

CF:
NCBED-PE

Butler ________
Berkeley________
Bennett________
Hammoser________
Zorich ________
Pieczynski______
Hallock/________
Liddell________
Braun ________

Environmental Clearance Officer
U. S. Department of Housing
and Urban Development
60 East Main Street
Columbus, OH 43215

State Conservationist
USDA Soil Conservation Service
200 North High Street
Columbus, OH 43215

Regional Administrator
U. S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, IL 60604

Refuge Manager
U. S. Fish and Wildlife Service
Ottawa National Wildlife Refuge
14000 W. State Rte. 2
Oak Harbor, OH 43449

Lucas County Planning Commission
435 Michigan Street
Toledo, OH 43624

Toledo Metropolitan Area
Counsel of Governments
123 Michigan Street
Toledo, OH 43604

Jerusalem Township Trustees
Route 1
Curtice, OH 43412

Ohio Department of Natural Resources
Division of Water
Coastal Zone Management Program
Fountain Square
Columbus, OH 43224

UNITF' STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

REPLY TO ATTENTION OF:

10 JUN 1981

Lt. Col. Thomas R. Braun
Deputy District Engineer
U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

RE: NCBED-PE

Dear Colonel Braun:

We are responding to your letter of April 16, 1981 which requested comments on the proposed shoreline erosion and beach restoration project at Maumee Bay State Park, Lucas County, Ohio.

The action proposed does not conflict with any agency construction grant projects, water quality management plans, or water supply projects in the Maumee Bay State Park Area.

We look forward to reviewing the Draft Environmental Impact Statement for this project. Please contact Rick Pitorak of my staff at FTS 886-6689 for any further matters relevant to this project.

Sincerely yours,

Barbara Taylor Backley

Barbara Taylor Backley, Chief
Environmental Impact Review Staff
Office of Environmental Review

United States Department of Agriculture

Soil Conservation Service

200 North High Street
Room 522
Columbus, Ohio 43215

April 27, 1981

Lieutenant Colonel Thomas R. Braun
Deputy District Engineer
Buffalo Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Braun:

This letter is in response to your request for information relative to interests our agency may have in the area of your shoreline erosion and beach restoration study at Maumee Bay State Park, Lucas County, Ohio.

The area of your study is included in the Lucas Soil and Water Conservation District (SWCD). The U.S. Soil Conservation Service (SCS), by agreement, provides some technically trained people to assist the District. James R. Rickenberg is the District Conservationist assigned to the Lucas SWCD. He will be available if you need assistance in planning vegetative measures to protect the shore area. The local SCS office is located in the Post Office Building at Maumee, Ohio 43537. The Post Office Box is 458, and the telephone number is (419) 259-6284 or FTS 625-6284.

We are not aware of any prime or unique farmland in the described project area. Please let us know if we can be of further assistance.

Sincerely,

Robert R. Shaw
State Conservationist

cc: J. Rickenberg, DC

ODNR
Ohio Department of Natural Resources
DIVISION OF NATURAL AREAS & PRESERVES
Fountain Square • Columbus, Ohio 43224 • (614)XXXXXXX 466-8970

May 19, 1981

Mr. Kenneth R. Hallock
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagra Street
Buffalo, New York 14207

Dear Mr. Hallock:

At this time, the Heritage Program has no records for rare plant species in Maumee Bay State Park. The attached lists of animal species were taken from 1980 reptile and bird surveys of the Lake Erie marshes. Bartramia longicauda, the Upland Sandpiper, is the only species listed as state endangered. I suggest you contact Elliot Tramer for information on habitat requirements of bird species recorded for Maumee Bay State Park. Dr. Tramer can be reached at the University of Toledo, Department of Biology, 2801 W. Bancroft Street, Toledo, Ohio 43606, (419) 537-2451.

Because the Heritage Program has not surveyed Ohio and relies on information supplied by a number of individuals and organizations, a lack of records for any particular area is not a statement that special plant or animal species are absent from a site.

Please contact me if I can be of further assistance. There is no charge for this search.

Sincerely,

Patricia D. Jones
Ecological Analyst

PDJ/sl

Enclosures

BREEDING BIRDS OF OHIO'S LAKE ERIE MARSHES

Prepared by

Elliot J. Tramer, Ph.D.

and

Eric J. Durbin

for

The Ohio Department of Natural Resources

Division of Natural Areas and Preserves

15 October 1980

IV. Summary of wetlands-nesting species by parcel. Migrants, non-nesting incidental visitors, and species of adjacent terrestrial habitats are excluded. Status designations: A - abundant, C - common, F - fairly common, U - uncommon, R - rare. Parcel numbers refer to the list in part II.

PARCEL   Parcel #1 = Maumee Bay State Park

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Pied-billed grebe		F			F	F	F		F	U					F	U	U							
Great blue heron *Ardea herodias*	U	A	F	F	A	C	A	A	F	A	F	C	U	U	A	C	C	U	U	U	F	U	R	R
Green heron		U	U	U	U	U	F	U	F	U	U	U			F	F	R	U	U		R	U		F
Great egret *Casmerodius albus*	U	A	F	F	C	C	C	A	F	F	U	F		U	F	C	F	F			R	U		
Black-cr.night heron		C	F	F	F	C	C	A	C	C		U	U	U	U	C	U			R		U		
Least bittern		U																						U
Canada goose		C			A	C	C	U	C	F		F				U	R							
Mallard *Anas platyrhynchos*	F	A	F	U	A	A	C	A	U	A		F		U	A	C	F	U	F		U	F	R	F
Black duck		U			R			R							R									
Gadwall					R											R								
Pintail *Anas acuta*	U	R			U		U								R									
Green-winged teal		U			U	F	U			U					U	U								
Blue-winged teal *Anas discors*	F	C			C	C	F	C		F					C	U								
American widgeon		R			R	R	R	R							R									
Shoveller					U	U																		
Wood duck		A			F	F	C	F	C	F					U	U	U	F		F			R	F
Ruddy duck		R						R							U	R								
Hooded merganser					R				R															

TABLE IV. Continued:

PARCEL Parcel #1 = Maumee Bay State Park

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Bald eagle		R			R										R								
Marsh hawk					R																		
King rail		R				R																	
Virginia rail		U			R	U		U							U	F	U					R	
Sora		U		U				U	R						U	F						R	
Common gallinule		C			U	U	F		R	U		R			U	U							
American coot		C		F	F	A	F	U	R	F					C	C	F			U			
Killdeer Charadrius vociferus	U	F		R	C	C	F	C	U	C	U	U		U	C	C	C	U			U		
Common snipe					R	U		R								R							
American woodcock					R															R	U		
Spotted sandpiper Actitis macularia	U	F			F	F	U	F		F					F	F	F		F		F	R	
Wilson's phalarope					R																		
Herring gull Larus argentatus	U	A		U	F	U	F	C	U	C		C			F	C	C		U	U	A	R	
Ring-billed gull Larus delawarensis	U	C		U	F		F	C		C		C				U	F			U	U		
Common tern		F				R		F									R		F		U		
Black tern		F			R	F	F	C								R	R				U		
Belted kingfisher							F	U		R			R	U		U	R	R					
Red-headed woodpecker		U			R			U				U					R				R	R	

TABLE IV. Continued:

PARCEL — Parcel #1= Maumee Bay State Park

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Eastern kingbird *Tyrannus tyrannus*	U	U			F	U	F	F	U	U		U	U		F	R	U	F	U		U	U		U
Eastern phoebe					?																	R		
Willow flycatcher *Empidonax traillii*	U	U			F	U	R		U	F	U		U		F	R	U	R			U			F
Tree swallow *Iridoprocne bicolor*	F	C	F		A	A	C	C	A	A		C	C	C	A	A	C	F	F	C	U	U		F
Barn swallow *Hirundo rustica*	F	F	F	U	C	C	F	F	C	C		C	C	C	A	U	U	U		F	U		U	
Purple martin		F			C	A	A	C	U	U		C	C	C	A	C	U		F	F	U	F	U	C
Long-billed marsh wren		C		C	U	C		F				F		R	C	C	F			U		U		F
Red-winged blackbird *Agelaius phoeniceus*	A	A	C	F	A	A	A	A	A	A		A	C	C	A	A	A	A	C		C	F	F	A
Warbling vireo		F			F	R	F	U	U	U				U	U		U	F			F			R
Prothonotary warbler					R		R	R		R														
Yellow warbler		C	F		A	A	A	F	C	A	U	C	C	U	A	U	U	U				U		F
Yellowthroat *Geothlypis trichas*	U	U			C	F	F	F	U	C	U	F		U	F	U	F	F			U	F		C
Swamp sparrow		R			R	R									U			F				F		F
Song sparrow *Melospiza melodia*	A	C			C	A	C	A	U	A		C	C	F	A	F	A	C	F	U	U	C	U	A

Non-Wetland Species Recorded For Maumee Bay State Park

* Upland Sandpiper - *Bartramia longicauda*, probable nester, OWE

* Marsh Hawk - *Circus cyaneus*, common migrant, winter visitant & possible nester, T

* Short-Eared Owl - *Asio flammeus*, unsuccessful nesting in April, 1980, T

Western Meadowlark - *Starnella neglecta*, nested sucessfully in 1980, present in other years

Bobolink - *Dolichonyx oryzivorus*, many Pairs

* Dickeissel - *Spiza americana*, at least 6 males on territory June, 1980, T

* Grasshopper Sparrow - *Ammodramus savannarum* - at least 2 pair, status undetermined

* Species inventoried by Natural Heritage Program

Status Codes:

OWE: state endangered animal

T: threatened (not a legal designation)

NATURAL HERITAGE PROGRAM

REPTILE SURVEY ALONG THE WESTERN OHIO PORTION OF THE LAKE ERIE COASTAL ZONE

by Fred Kraus
and Gordon W. Schuett

June 16 to September 6, 1980

This survey was financed by a federal grant from the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, under the provision of Section 305 of the Coastal Zone Management Act of 1972 (PL92-583) through the Ohio Department of Natural Resources. The survey was conducted by the Division of Natural Areas and Preserves for the Ohio Coastal Zone Management Program.

Ohio Department of Natural Resources
Division of Natural Areas and Preserves
Fountain Square, Building F
Columbus, Ohio 43224

NILE'S WOODS: Maumee Bay State Park

Fox Snake *Elaphe vulpina gloydi*-- 6/18/80-- (1), 9:52am, 13", male.

melanistic sirtalis-- 6/18/80-- (2), 10:07am, 18", ?
10:25am, ?, ?.
Melanistic Garter Snake
7/4/80-- (1), 12:50pm, DOR.
7/21/80-- (1), 7:35am, 24", female.

Thamnophis sirtalis sirtalis-- (9), 9:52am
Garter Snake
9:55am
9:57am
10:00am all on 6/18/80
10:01am
10:06am
10:08am
10:25am
11:10am

7/4/80-- (3), 1:00pm
1:20pm
1:24pm
7/21/80-- (2), 7:55am
8:18am

Butler's Garter Snake
Thamnophis butleri-- 6/18/80-- (1), 10:08am
7/4/80-- (2), 12:25pm
12:55pm
8/11/80-- (1), 1:25pm

Nerodia sipedon sipedon-- 7/4/80-- (4), 12:35pm, 20"
Northern Water Snake
1:05pm, 30", male
1:09pm, 38", female
1:14pm, 34"

Blanding's Turtle
Emydoidea blandingi-- 6/18/80-- (4), 10:02, large female on land
10:33am, (3).

Map Turtle *Graptemys geographica*-- 8/11/80-- (1), 12:55pm.

Chrysemys picta marginata-- 8/11/80-- (1), 1:06pm.
Midland Painted Turtle

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

East Lansing Area Office
Manly Miles Building, Room 202
1405 South Harrison Road
East Lansing, Michigan 48823

Lt. Colonel Thomas R. Braun
Deputy District Engineer
U. S. Army Engineer District
Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Braun:

This responds to your letter dated April 16, 1981 to Mr. Harvey Nelson, Regional Director of the U. S. Fish and Wildlife Service regarding the proposed shoreline erosion and beach restoration study at Maumee Bay State Park, Lucas County, Ohio.

This letter provides comment only on the endangered species aspect of the project. Comments on other aspects of the project under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat 401, as amended; 16 U.S.C. 661 et. seq.) may be sent under separate cover.

To facilitate compliance with Section 7(c) of the Endangered Species Act of 1973 as amended, Federal agencies are required to obtain from the Fish and Wildlife Service information concerning any endangered or threatened species, listed or proposed to be listed, which may be present in the area of a proposed action. Therefore, we are providing you with the following list of species which may be present in the concerned area.

Classification	Common Name	Scientific Name	Habitat
Endangered	Indiana bat	Myotis sodalis	Caves and riparian
Endangered	Peregrine falcon	Falco peregrinus	Migratory
Endangered	Kirtland's warbler	Dendroica kirtlandii	Migratory
Endangered	Bald eagle	Haliaeetus leucocephalus	Breeds in Lucas, Ottawa, Sandusky, and Erie Counties in Ohio
Endangered	Blue pike	Stizostedion vitreum glaucum	Lake Erie

Enclosed for your information is a List of the Major Responsibilities Required of Federal Agencies under the Endangered Species Act of 1973, as amended.

Sincerely yours,

John Popowski
Area Manager

Enclosure

FEDERAL AGENCIES' MAJOR RESPONSIBILITIES UNDER THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

1. All Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered or threatened species.

2. In accordance with Section 7(c) of the Endangered Species Act of 1973, as amended, the Federal agency responsible for actions authorized, funded, or carried out in furtherance of a construction project that significantly affects the quality of the human environment, is required to conduct a biological assessment. The purpose of the assessment is to identify listed or proposed species likely to be adversely affected by their action and to assist the Federal agency in making a decision as to whether they should initiate consultation.

3. The biological assessment is to be completed within 180 days of initiation and before contracts are entered into or construction begun.

4. When conducting a biological assessment, the following steps should be taken:

   a. Conduct an on-site inspection of the area affected by the proposed activity or program, which may include a detailed survey of the area to determine if species are present and whether suitable habitat èxists for either expanding the existing population or potential reintroduction of populations.

   b. Interview recognized experts on the species at issue, including those within the Fish and Widllife Service, State conservation departments, universities and others who may have data not yet found in scientific literature.

   c. Review literature and other scientific data to determine the species' distribution, habitat needs and other biological requirements.

   d. Review and analyze the effects of the proposal on the species, in terms of individuals and populations, including consideration of the cumulative effects of the proposal on the species and its habitat.

   e. Analyze alternative actions that may provide conservation measures.

5. Sections 7(a) and (b) require agencies to consult with the Fish and Wildlife Service when the Federal agency determines their action "may affect" listed species or Critical Habitat. Formal consultation may be initiated by submitting a written request to the Area Manager, Fish and Wildlife Service, East Lansing Area Office, 1405 South Harrison Road, East Lansing, Michigan 48823. At this time, the agency should provide a copy of the biological assessment and other relevant information that assisted them in reaching their "may affect" decision.

6. Section 7(d) of the 1978 Amendment to the Endangered Species Act underscores the requirement that the Federal agency and the permit or license applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which in effect would deny the formulation or implementation of reasonable alternatives regarding their actions on any Endangered or Threatened species.

7. Definitions

   a. Technicial Assistance - information provided to State or private interest groups concerning Federally listed threatened or endangered species.

   b. Informal Consultation - information provided to Federal agencies concerning Federally listed species that may occur in a project area.

   c. Formal Consultation - A request by the Federal agency whose proposed project has been identified in the Biological Assessment, to impact listed species. The formal consultation process will ultimately result in the issuance of a Biological Opinion by the FWS to the Federal agency.

   d. Conservation - bringing a listed species to the point at which it may be removed from the List of Endangered or Threatened Wildlife and Plants.

   e. Reasonable Alternatives - courses of action open to the Federal agency that are technically capable of being implemented and consistent with the intended primary purpose of the activity, which would avoid jeopardizing the continued existence of listed species or destruction or adverse modification of Critical Habitat.

8. Federal agencies are advised to determine if State listed endangered or threatened species reside in the project area that may be adversely affected by the Federal Action. The State Department of Conservation should be contacted to make this determination.

R.F.—PLAN

ODNR
Ohio Department of Natural Resources

Fountain Square • Columbus, Ohio 43224 • (614[redacted])265 6886

July 28, 1982

Mr. Charles E. Gilbert
Chief, Planning Division
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Gilbert:

We have reviewed your July 8, 1982, letter regarding comments on your Draft Final Feasibility Report and Environmental Impact Statement for the Shoreline Erosion and Beach Restoration Study at Maumee Bay State Park. Attached are our responses to those items outlined in your cover letter.

If you require additional information, please feel free to contact this office.

Sincerely,

Robert W Teater

ROBERT W. TEATER
Director

RWT/dlw
Attachment

JAMES A. RHODES, *Governor* • ROBERT W. TEATER, *Director*

ODNR
Ohio Department of Natural Resources
Fountain Square · Columbus, Ohio 43224 · (614[redacted]265-6886

SHORELINE EROSION AND BEACH RESTORATION STUDY
AT MAUMEE BAY STATE PARK

Regarding the U.S. Public Health Services' concerns related to potential health effects, we offer the following:

a. Construction hazards - The Department of Natural Resources would provide for controlled access to any area within the park undergoing construction or site preparation. A standard clause in all contract specifications requires contractors to provide necessary barriers to prohibit access to work areas.

b. Recreational hazards - Where appropriate, potentially hazardous areas at the wildlife revetment, surface drainage ditches and shoreline jetties would be guarded with permanent barriers and signing. Park rangers and other park staff are trained in law enforcement and first aid and will provide additional protection through routine duties and patrol of the park areas. The offshore breakwaters must comply with Coast Guard standards applicable to navigable waters. The Ohio Department of Natural Resources' Division of Watercraft conducts the finest waterway safety program in the country. Division of Watercraft officers presently patrol Lake Erie waters including Maumee Bay. Shallow draft boats may approach the breakwaters for sportfishing purposes. It should be noted that Maumee Bay is extremely shallow, limiting boating uses.

The Department of Natural Resources cooperates with the Ohio Department of Health in water quality monitoring and will likewise cooperate with the state and local health departments in the monitoring and control of disease vectors. Other state parks on Lake Erie with similar developments in proximity to potential mosquito breeding areas have experienced no related human health problems.

There will be no problem with water velocities through gaps in the revetment affecting bathers since the public beach will be separated from the revetment by Berger Ditch and 250 foot long jetties. Public access to shoreline areas in the eastern end of the park will be controlled in accordance with the master plan for park development.

Regarding fecal coliform standards, the near shore waters must meet the bathing waters standard [Ohio Administrative Code 3745-1-07(I)]. The Department of Natural Resources will continue to conduct its water quality monitoring program to ensure that public health objectives of the State's water quality standards are met.

Regarding the Ohio Environmental Protection Agency comments: We feel that they are addressed in ODNR's comments of 25 May 1982 on the draft Environmental Statement and Appendix I, Wetland Field Report. (comment no. 3)

Regarding the TMACOG comment on the Access Road Study:

As you are aware ODNR has completed an engineering study for the access roads to Maumee Bay State Park and we still believe this study to be valid. However, since the park will not be completed for several years we will re-evaluate the conclusions of the report when needed to determine if the situation has changed. Any improvements to the access roads will be undertaken as funds are available and park facilities are constructed. Further refinement of the access roads to be improved will be coordinated with local planning and governmental agencies.

Regarding the Maintenance of the Drainage System:

Drainage ditches on Maumee Bay State Park property will have to be maintained and kept operable by ODNR in order to prevent flooding upstream and to protect ODNR development and interests.

Regarding Suitability of Soils:

We are aware that the Latty and Toledo soils are severe for those recreational facilities that are in the master plan for Maumee Bay. Among the reasons for choosing this site included versatility, available open space, water orientation for water related activities, good access and close proximity to the population of north western Ohio. With the construction of the campground we have found that through effective grading and filling, the existing soils are adaptable and can support the facilities we have proposed for the site.

APPENDIX J
PUBLIC VIEWS AND RESPONSES

MAUMEE BAY STATE PARK, OH

FINAL FEASIBILITY REPORT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

OFFICE OF THE ADMINISTRATOR

July 14, 1982

Colonel George P. Johnson
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

1. This is in reference to your draft environmental impact statement entitled *"Maumee Bay State Park, Ohio, Shoreline Erosion-Beach Restoration Study."* The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving four copies of the final environmental impact statement.

Sincerely,

David Cottingham for
Joyce M. Wood
Director
Office of Ecology and Conservation

Enclosure:

Memo from : Eugene J. Aubert
Environmental Research Laboratories

CORPS RESPONSES TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
(Letter dated 14 July 1982)

1. Thank you for your comments. Four copies of the Final Environmental *Impact Statement will be sent.*

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Great Lakes Environmental Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, MI 48104

Rec'd 7/6/82
EC:dw

June 29, 1982

TO: PP/EC - Joyce Wood

FROM: RD/RF24 - Eugene J. Aubert

SUBJECT: DEIS 8205.24 - Maumee Bay State Park, Ohio

The subject DEIS prepared by the Corps of Engineers, Buffalo District, on shoreline protection at the Maumee Bay State Park has been reviewed and comments herewith submitted.

2. Development of the Maumee Bay State Park as a multi-use recreational complex is highly commendable as it will serve the large Toledo metropolitan area. The park extends for two miles on Lake Erie shoreline which is recognized as the most critically eroding shoreline on the south shore of the lake.

2. Comment noted.

3. The ongoing high shoreline erosion depends on the energy of waves and currents acting near shore and on the resistance of shore material to erosion. Development of waves in the vicinity is very restricted by Lake Erie hydrography. About four miles to the north a navigation channel leading to Toledo Harbor is flanked on both sides by shoals and small islands formed by dredge spoil. Purpose of such placement of spoil was to eliminate currents flowing across the channel and to reduce channel shoaling by fine bottom sediment. On the east side of park site a small island, about 2,000 feet long, and a large shoal area extend north from the Little Cedar Point. The complex and very restrictive hydrography makes the estimate of design waves a difficult task and not very reliable. In any case waves in this vicinity should be of rather limited size. It appears that the excessive erosion exists mostly due to highly erosible clay or fine silt soils. Minimum wave action suspends the fine particles and moves them into deeper parts of Lake Erie. Standard relationship between wave energy and movement of suspended particles should be at least very weak.

3. Comment noted.

4. Measures to control shoreline erosion were designed to be in agreement with the planned park use. The eastern part of the park will remain essentially in natural state and the shoreline will be protected by a 6,200-foot-long revetment. Various interested parties agree that the shore protection by revetment will serve best the intended park use. We concur with the findings. The western part of the park will be developed fully for public use. A protective beach and possibly series of detached breakwaters are proposed to protect this one-mile-long shoreline. Here several project alternatives have been developed and evaluated. Final selection was reduced to two alternatives. Alternative 2a would provide only a protective sand beach. Since this alternative would preserve and maintain the existing wetland at the park and is the least disruptive to existing current and drift patterns at the shore,

4. No response necessary.

it has been selected as the Environmental Quality (EQ) Plan (page EIS-24). Alternative 3b would provide a protective beach and series of detached breakwaters. Since this plan maximizes benefits and meets all planning objectives, it has been chosen as the National Economic Development Plan (NED) as well as the tentatively Selected Plan (page EIS-28). Our review of the proposed alternatives and comments follow.

5. Alternative 2a would provide a 5,500 foot long sand beach with a storm dune behind it. The beach will be directly exposed to storm waves and the estimate of potential sand loss from the beach is the major problem and uncertainty. Erosion of sand fill and deposition of eroded sand will respond to two forces - wave action and longshore currents. Waves will suspend the sand particles and currents will carry them away. Based on hydrography currents should not be high and waves would just modify the fill area. They would erode sand fill and deposit it in depths where at the bottom wave action becomes insignificant. The erosion will appear as sand loss, however it would be a highly desirable improvement of the swimming area. According to design, sand fill would extend only to about two feet water depth, beyond which the bottom would remain clay and fine silt. Water would become turbid when disturbed by swimmers. As mentioned, modification of sand fill would ameliorate this condition. Observations on other beach fills with insignificant longshore currents show that, after adjustment of shoreline profile to fit wave climate, sand loss from shoreline becomes greatly reduced. Estimated annual sand losses of about 20,000 cubic yards are probably high in view of limited potential of wave formation and entirely different resistance to erosion of the medium sand fill as compared with the present silt and clay shore. Due to sand losses to shoreline adjustment, initial fill of higher volume would be of advantage.

6. Alternatives 3a and 3b were designed to reduce need for annual sand replenishment. Both alternatives would retain a somewhat modified sand beach and add a series of breakwaters. Breakwaters would be placed in six-foot water depth and in height they would extend 6.9 feet over average lake level. Breakwaters would allow only minor overtopping during the 200-year return period. We consider the breakwater height as being far too excessive. Their purpose is to break larger waves before reaching shore. Much lower breakwaters would serve the purpose. Overtopping by the waves would be of advantage by providing additional flushing of the beach area. In addition, high breakwaters would degrade the aesthetics of environment by blocking lake view. Water depth at the breakwaters should be not less than six feet at all locations to eliminate temptation for nonswimmers to reach the breakwaters. Unexpected scour holes might endanger life.

7. Due to the difficulty to estimate sand losses and maintenance costs, two tests were initiated at the site. The first test involves observations on waves, wind, beach, and currents. The second test involves behavior of sand placed in the littoral zone in a groin-like configuration. It appears that in first test the most important factor is the longshore currents. Strong currents would indicate movement of sand out of project shoreline. Lack of such currents indicates that sand would remain in the reach despite some shifting by the waves. The experimental groin containing 50 cubic yards of sand will definitely show larger percentage of sand loss than that from a sand fill of 275,000 cubic yards.

5. The prediction of beach profiles and nourishment rates are difficult to assess especially in an area such as Maumee Bay. The extreme flatness of the nearshore area and unusual erosion characteristics of the shoreline make it unique from any other coastal environment on Lake Erie. As an attempt to better understand coastal processes, two littoral based tests were performed with the results being presented in the Final Feasibility Report. Considerable information and insight was gained from the tests, however, their use as a foundation for establishment of nourishment and backpassing rates is not possible nor realistic. Due to the nature and scale of the tests, the final results are considered inconclusive. Due to these reasons and to the general air of uncertainties to just how an unprotected beach may react, the conservative figure of 20,000 cubic yards/year of nourishment is considered adequate.

6. Breakwater crest elevations were calculated based on a maximum 3.0 feet transmitted wave during design conditions. Their purpose is to prevent storm waves from eroding the beach and since storm waves basically occur only during extreme water levels, it is necessary to keep the breakwaters at a +9.4 elevation. The design water level is 576.5 IGLD and the breakwater crest elevation is 578.0 IGLD which leaves only 1.5 feet of freeboard under design conditions. Since it would take only one storm to cause considerable damage to the beach, a crest elevation of this height is warranted. In the design stage of the project, refined procedures will be used to compute transmitted wave heights which may slightly alter the final crest elevation. With regard to swimmers reaching the breakwaters, it is anticipated that a swimming area would be established to confine swimmers to a restricted area. Even though the area would be somewhat shallow, it would not be safe to allow swimmers to venture upwards of 700 feet from shore.

7. No response necessary.

Our review indicates that the erosion problem of an unprotected beach should be less severe than estimated. Effect of waves and currents, both of limited magnitude as they exist in Maumee Bay environment, on a shore consisting of medium size sand, should not be very high and probably rather low. For this reason it is suggested that the project be implemented in steps.

8. First step should be to construct the shore protection according to plans of alternative 2a. At the same time, as suggested in DEIS, a 5-year observation program should be started with recording of waves and currents and periodic surveys of sand losses. If sand losses, except those for modification of shoreline profile, prove excessive, a system of low breakwaters should be constructed.

9. Two discrepancies were noted and require clarification. The average Lake Erie water level is correctly listed as 1.75 feet above the low water datum (LWD) on page 20, but is shown as 2.5 feet above the low water datum on Plate EIS-8. The segmented detached breakwaters are constructed at a depth of 6 feet below LWD as given in paragraph 3.3.4 on page EIS-24, but are shown on Plate EIS-11 as being constructed at a depth of 3 feet below LWD.

8. Staged construction was given serious consideration during preparation of the preliminary feasibility report. However, this approach was terminated for the following reasons:

a. Possible high nourishment and backbassing costs, which could actually exceed the first cost of breakwater construction prior to their construction;

b. The project sponsor is not in favor of this proposal because of the uncertainties associated with beach maintenance and the fact that current legislatures have no authority to obligate future funds.

9. The average lake level of 1.75 feet above LWD is the average annual level for the period 1900-1979 but is also equal to 1.90 for the period 1860-1981. The lake level of 2.5 feet above LWD as shown on the various plates throughout the report corresponds to the approximate average level during the swimming months (May-September). This level more nearly represents the lake stage during recreational beach activities. The final report has been modified to indicate more clearly what this level represents. Paragraph 3.3.4 has been revised to state that the breakwaters would be constructed at a depth of 6 feet below normal lake level not 6 feet below LWD.

CORPS RESPONSE TO THE OHIO STATE CLEARINGHOUSE
(Letter dated 29 June 1982)

STATE CLEARINGHOUSE

30 EAST BROAD STREET • 39TH FLOOR • COLUMBUS, OHIO 43215 • 614 / 466-7461

82-06-29 P
09

George P. Johnson, Colonel
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

RE: Review of Environmental Impact Statement/Assessment
Title: Draft Environmental Impact Statement--Maumee Bay State Park Shoreline Erosion--Beach Restoration, Lucas County, Ohio.
SAI Number: 36-422-0019

Dear Mr. Johnson:

The State Clearinghouse coordinated the review of the above referenced environmental impact statement/assessment.

1 This environmental report was reviewed by all interested State agencies. No reviewer has stated concerns relating to this report.

Thank you for the opportunity to review this statement/assessment.

Sincerely,

Judith Y. Brachman
Lew

Judith Y. Brachman
Administering Officer

JYB:alf

cc: DNR, Mike Colvin
EPA, Anthony Sasson

1. No response necessary.

United States Department of the Interior

OFFICE OF THE SECRETARY
NORTH CENTRAL REGION
175 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60604

ER-82/791

June 25, 1982

Colonel George P. Johnson
District Engineer
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, N.Y. 14207

Dear Colonel Johnson:

This will respond to your request for Departmental review and comments of the draft Environmental Statement and Feasibility Report, Shoreline Erosion and Beach Restoration Study, Maumee Bay State Park, Lucas County, Ohio.

1. In December 1981, the Fish and Wildlife Service's Columbus Field Office was given an opportunity to review advance copies of the subject reports. Comments were provided on these documents in a letter dated January 26, 1982. A copy of this letter was included in Volume 2, Appendix G, of the revised April 1982 report. The latest revisions which were made to the documents have not altered our evaluation of the proposed alternatives and their impacts on fish and wildlife resources. The Department concurs with the Fish and Wildlife Service's position. This position was stated in the Draft Fish and Wildlife Coordination Act Report dated December 8, 1981 (also contained in Appendix G of Volume 2) and in their letter of comment dated January 26, 1982.

2. At this time, the major concern with the Corps of Engineers' proposed project is the use of a lake source for sand with Alternatives 2 and 3. Although the Bureau of Mines reports no significant mineral involvement with the project, it has recommended that sand be obtained from an upland source. We wish to reemphasize the need for ichthyoplankton and fisheries studies to fully assess impacts on the fisheries resource if the sand spit off Little Cedar Point is to be the sand source for the proposed recreation beach at Maumee Bay State Park.

3. We would appreciate your office maintaining close coordination with the Fish and Wildlife Service's Columbus Field Office as the project develops. You may contact them at the following address or phone

CORPS RESPONSES TO U.S. DEPARTMENT OF THE INTERIOR
(Letter dated 25 June 1982)

1. All U.S. Fish and Wildlife Service concerns and recommendations have been addressed in the Final Feasibility Report and Environmental Impact Statement and have been used in the evaluation of alternatives.

2. Ichthyoplankton and fisheries studies would be conducted during advanced engineering and design phases of the study if the Little Cedar Point sand spit is to be used as a source of beach fill.

3. Close coordination with the Fish and Wildlife Service's Columbus Field Office will be maintained throughout the study.

number: United States Fish and Wildlife Service, Columbus Field Office, 3990 E. Broad Street, Columbus, Ohio 43215; telephone: FTS: 943-6923, or commercial: 614/231-3416.

The Department appreciates the opportunity to respond to this project.

Sincerely yours,

Sheila Minor Huff

Sheila Minor Huff
Regional Environmental Officer

cc: ODNR - Div. of Wildlife, Columbus, OH
ODNR - Outdoor Recreation Serv., Columbus, OH
USEPA - Office of Envir. Review, Chicago, IL
Ohio EPA - Columbus, OH

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta, Georgia 30333
(404) 262-6649

June 25, 1982

Mr. William Butler
U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Butler:

We have reviewed the Draft Final Feasibility Report and Draft Environmental Impact Statement (EIS) for the Maumee Bay State Park--Shoreline Erosion Beach Restoration Study on Lake Erie near Toledo in Lucas County, Ohio. We are responding on behalf of the U.S. Public Health Service and are offering the following comments for your consideration in preparing the final document.

1. We understand that the Maumee Bay State Park when completed will consist of 1,855 acres of lakefront property. To achieve the needs identified for the Maumee Bay State Park which include the elimination of 11,000 feet of shoreline erosion, restoration of a 5,500-foot recreational beach, and protection of 244 acres of wetlands, the tentatively "Selected Plan," Alternative 3b, has been proposed.

2. We believe the EIS should discuss the potential public health effects and mitigation plans associated with the "Selected Plan" and each of the other alternatives. These public health effects could include construction hazards, recreational hazards involving the wildlife revetment, offshore breakwaters and breakwater gaps (falls, water safety problems, watercraft safety, etc.), and the need for any additional mosquito control and surveillance measures because of possible increased human exposure to vectors due to the enhancement and/or construction of new or existing recreational areas and facilities (campgrounds, picnic areas, lodge, golf course, etc.) adjacent to the proposed 244-acre wetland preservation area, ponds, and other potential mosquito breeding areas. Will water velocities back through the breakwater gaps pose a water safety problem to bathers?

3. We trust that the materials used to construct the revetment, breakwater and beach areas will consist of clean materials free of toxic or hazardous substances that could cause adverse health effects.

4. With regard to water quality (page EIS-41), this section should be expanded to more clearly disclose the past compliance of the Maumee Bay State Park bathing beach waters with the Ohio Water Quality Standards (Ohio Administrative Code Regulations 3745-1-07 (I)) for bathing waters and the standards and regulations for beach closure by the Ohio Department of Health.

CORPS RESPONSES TO U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
(Letter dated 25 June 1982)

1. No response necessary.

2. On 8 July 1982, the Ohio Department of Natural Resources (ODNR) was contacted with respect to mosquito control and surveillance measures and water safety within the park. Their input (see Appendix I, p. I-34) has been included in paragraph 5.4.3, EIS-44 which discusses the public health effects of each alternative and possible mitigation measures. Regarding watercraft safety, the Federal Government (U.S. Coast Guard) would be responsible for placing navigation aids on any breakwaters which might be constructed. Velocities through the gaps in the breakwaters would not pose a water safety problem to bathers. Under design conditions which would occur infrequently, and during which, conditions would not be conducive to swimming, velocities through the gaps would be less than 0.5 feet/second. Velocities through the gaps under average, normal conditions would be negligible, and not a factor in swimming safety.

3. The U.S. Department of Health and Human Services is correct in assuming that construction materials would be clean and free of toxic or hazardous substances.

4. The <u>Water Quality</u> section (p. EIS-41) has been revised to discuss past compliance of the Maumee Bay State Park waters with Ohio Water Quality Standards. Ohio Department of Health standards and regulations for beach closure are also discussed.

5. Maumee Bay/Toledo Harbor which include the Lake Erie waters contiguous to the Maumee Bay State Park are designated as an "Excepted Area" from the Lake Erie Standards of the Ohio Water Quality Standards (3745-1-11(C)). If these bay waters are exempted from meeting a Lake Erie fecal coliform standard (3745-1-11(A)(12)) that is as stringent as the bathing waters standard (3745-1-07(I)), is the restoration of a bathing beach in an "Excepted Area" of Lake Erie compatible at this time with the public health objectives of the Ohio Water Quality Standards (3745-1-01) and Section 101 of the National Environmental Policy Act?

6. The EIS should describe the nature and effect of local ditch discharge waters and any other discharge sources in the vicinity upon beach water quality. The effect of any sewage treatment facility discharge or industrial discharges in Maumee Bay that could adversely impact water quality and public health at the proposed beach should also be assessed and disclosed in the EIS.

7. Since the project will improve and preserve the recreational resources of the Maumee Bay State Park and since improved safety and health practices should be a goal for recreational activities, we recommend that consideration be given to the suggested guidance outlined in the publication, Environmental Health Practice in Recreational Areas. We also recommend that project sponsors consider the information contained in the publications: Youth Camp Safety and Health Guidelines - Swimming, On the Trail, and Watercraft. Copies of these documents are enclosed.

8. We appreciate the opportunity to review the Draft EIS. Please send us one copy of the final document when it becomes available. Should you have any questions about our comments, please call Mr. Robert Kay of my staff at FTS 236-6649.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Center for Environmental Health

4 Enclosures

5. Although the Lake Erie waters contiguous to the park are an "Excepted Area" from Ohio Water Quality Standards, the Ohio Department of Health would apply the Bathing Waters standards to the proposed restored beach. As indicated on page EIS-41, Lake Erie waters at the park meet these standards under normal conditions and, therefore, the restoration of a bathing beach should not endanger the public health.

6. Paragraph 4.2.5 have been revised to include an assessment of Local discharge waters and their effect, if any, on Maumee Bay State Park.

7. The recommendations presented in these publications will be considered. Copies have also been recommended to ODNR.

8. Thank you for your comments. Once copy of the Final Feasibility Report and Environmental Impact Statement will be sent upon its release.

ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST
CHICAGO, ILLINOIS 60604

REPLY TO ATTENTION OF:

CORPS RESPONSES TO USEPA
(Letter dated 10 June 1982)

Colonel George P. Johnson
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

10 JUN 1982

RE: NEPA-DE-COE-F30014-OH(82054)

Dear Colonel Johnson:

1. The U.S. Environmental Protection Agency has reviewed the draft Environmental Impact Statement (EIS) for the proposed shoreline erosion control and beach restoration project at Maumee Bay State Park, Ohio.

2. The action proposed in the draft EIS is the control of beach erosion and the development of a swimming beach at Maumee Bay State Park, on the shore of Lake Erie near Toledo, Ohio. The preferred alternative is the construction of a protective sand and turf beach 250 feet wide by 5,500 feet long over the western half of the park. This area would be stabilized by eight 300-foot offshore, rubblemound breakwaters. The eastern half of the park would be protected by a rubblemound revetment placed along the existing shoreline. Interior drainage ditches would be protected by rubblemound jetties.

3. Based on our review of the draft EIS, we concur with its findings that, the preferred alternative (identified in the EIS as alternative 3b) will result in a minor environmental impact and that the impact can be adequately mitigated; thus, we are rating the proposed project LO-1. The rating means we lack objections (LO) to the project's environmantal impact and there is sufficient information (1) in the EIS to assess the impact.

4. Our review is made pursuant to our responsibilities under the National Environmental Policy Act and Section 309 of the Clean Air Act. These authorities require us to review and comment, for the public record, on the environmental impact of proposed Federal actions. Accordingly, a notice of the availability of our comments will be published in the Federal Register.

If you have any questions about our review, please call Mr. James Hooper of my staff, at 312-886-6694.

Sincerely yours,

Barbara Taylor Backley

Barbara Taylor Backley, Chief
Environmental Review Branch
Planning and Management Division

1. No response necessary.

2. No response necessary.

3. Comment noted.

4. No response necessary.

OhioEPA

June 4, 1982

Colonel George P. Johnson
District Engineer
Department of the Army
Buffalo District, Corps of
Engineers
1776 Niagara Street
Buffalo, New York 14207

Re: Maumee Bay State Park, Ohio, Shoreline Erosion - Beach Restoration Study - Draft Environmental Impact Statement.

Dear Colonel Johnson:

1. The Ohio EPA has reviewed the above referenced report and suggests that Alternative 3b be considered as a reasonable choice. The small loss of wetlands associated with this alternative is acceptable considering the amount to be protected from future erosion. While the Agency supports the Ohio Department of Natural Resources' efforts to develop the recreational potential of the area, additional alternatives should be investigated concerning the potential wetland losses due to the construction of the golf course or other secondary development.

2. The opportunity to comment is appreciated. If you should have any questions concerning the wetlands impacts related to the Park's development and their mitigation, please contact John Albrecht of the Division of Wastewater Pollution Control, (614) 466-9092.

Very truly yours,

Wayne S. Nichols
Director

WSN/ars
12033.0

cc: John Albrecht, DWPC
Reading
File

CORPS RESPONSES TO OHIO EPA
(Letter dated 4 June 1982)

1. The Buffalo District agrees and has selected Alternative 3b as the preferred alternative. ODNR has indicated their awareness of potential wetland losses and have assured the Corps that other alternatives would be evaluated and mitigation measures, if required, would be implemented.

2. If questions arise concerning wetland impacts related to the park's development and their mitigation, OEPA will be contacted.

ODNR
Ohio Department of Natural Resources
Fountain Square · Columbus, Ohio 43224 · (614) [redacted] 265-6886

May 25, 1982

George Johnson, Colonel
District Engineer
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Re: Draft Final Feasibility Report and EIS
Maumee Bay State Park - Revised April 1982.

Dear Colonel Johnson:

1. The report has been reviewed by departmental personnel and all concur in the acceptability of the tentatively selected plan, Alternative 3b. The cost analysis confirms the feasibility of this alternative.

2. Alternative 2a, as well as having uncertainties, would have a future undesirable impact on local roads if sand is delivered by truck. The breakwaters will have additional value on fish structures and may enhance boat-fishing opportunities.

The following comments are offered for consideration in later stages of the study.

3. 1) The wildlife revetment (Appendix D) is designed for some overtopping of waves with crest height of +8.0 feet and has gaps 'at Santee Ditch and midway along the revetment in order to permit exchange of water and maintain the wetland environment'. The change in water levels within the wetland due to overtopping and other hydraulic head differences, will cause various currents through the revetment gaps. These velocities should be evaluated. In connection with the overtopping, what are the maximum water levels in the wetlands to be expected and for what duration? Will local flooding of surrounding property result from the design storm?

4. 2) Fish and wildlife coordination report (Appendix G): The views of the Division of Wildlife and Parks and Recreation are partly expressed in correspondence attached to the U.S. Fish and Wildlife Service's Draft Report (Appendix G). The departmental response on this advance review of the draft final report and draft environmental statement should indicate that applicable comments are made under the authority of the Fish and Wildlife Coordination Act.

JAMES A RHODES *Governor* • ROBERT W TEATER *Director*

CORPS RESPONSES TO OHIO DEPARTMENT OF NATURAL RESOURCES
(Letter dated 25 May 198)

1. Comment noted.

2. It is acknowledged that Alternative 2a, with its greater annual nourishment requirements, would have a proportionately greater adverse impact on local roads than the other alternatives. If, as anticipated, the breakwaters proposed in Alternatives 3a and 3b help diversify benthic habitat and thereby the local sport fishery, boat-fishing opportunities may also be enhanced.

3. Other concerns have arisen pertaining to the design of the wildlife revetment not only from an inland flooding point of view but also from fish and wildlife needs. These needs are based on the belief that there are not enough gaps in the revetment as currently visualized to provide adequate passage for fish between the lake and wetlands. The detailed design would, therefore, reflect the need to incorporate more gaps which would also minimize any possible hydraulic head differences. Computations would still be performed to verify that velocities in the gaps would be excessive and that wetland flood levels would not substantially exceed the corresponding lake flood levels. At most, it is believed the presence of the revetment would lessen local flooding, however, this would depend on the size and duration of the storm.

4. Comment noted and referred to the U.S. Fish and Wildlife Service.

5. The Fish and Wildlife Service's report should have described what the department has done already in designating and managing areas of the park for wildlife management. Noteworthy is the 125 acre meadow-management area to benefit short-eared owls, other raptors and migrating, transient and nesting species of birds and other wildlife.

6. We strongly concur in the U.S.F.W.'s recommendation (#9) to the Corps that the 100 foot gap(s) in the wildlife revetment should be located to optimize fish access and water circulation, when lake levels permit, in the marsh area behind the revetment. The measures would be consistent with the planned use and management of this area. During the Wetland Field Inspection (Appendix I) it was observed that the wetland habitat at the far east shore near Anderson Ditch contained deeper channel-like areas extending into emergent persistent vegetation. This habitat may be more valuable to certain fish species or life stages of fish species.

7. 3) Wetland Field Report (Appendix I): We are aware that any filling in wetlands in conjunction with future park development will require authorization under Section 404 of the Clean Water Act. Proposed developments in wetlands would involve evaluation of alternatives and identification and implementation of mitigating measures.

8. 4) Main Report, Environmental Setting. j. Water Quality (page 24): The water quality standards for bathing beaches in Ohio require the following criteria be met:

> Geometric mean fecal coliform content, based on not less than five samples within a 30 day period, shall not exceed 200 per 100 ml, and shall not exceed 400 per 100 ml in more than 10 per cent of the samples taken during any 30 day period.

Ohio Department of Health, in cooperation with the Department of Natural Resources, provides fecal coliform beach sampling analysis at 29 Lake Erie beaches and at all state parks with public beach facilities. A continuing sampling program for Maumee Bay State Park proposed beach is being developed with the Department of Health.

We appreciate the opportunity to comment on this report.

Sincerely,

MELVIN J. REBHOLZ
Acting Director

MJR:bm
cc: Robert Lucas
Donald Olson
Steve Cole
Roger Hubbell

5. The USFWS has been requested to include a description of ODNR's wildlife management plans.

6. The optimum location of gap(s) in the wildlife revetment will be evaluated during future detailed design studies.

7. Comment noted.

8. Page 24 has been revised to state that the more stringent standards for Bathing Waters would go into effect if a beach were to be restored and developed at the park. Coordination with the Ohio Department of Health would be continued to insure that fecal coliform levels would not pose a health hazard to bathers.

Toled(Metropolitan Area C(.uncil of Governments

123 Michigan Street Toledo, Ohio 43624-1996

May 24, 1982

George P. Johnson, Colonel
Corps of Engineers
District Engineer
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

RE: DFFR and DEIS Maumee Bay State Park, Ohio, Shoreline Erosion - Beach Restoration Study

Dear Colonel Johnson:

1\. Please be advised that we take exception to your statement on pages 41 and 44 concerning the transportation system: ". . . the area surrounding Maumee Bay State Park has an extensive, diversified transportation system which includes highways, major airports, shipping, and railroads." The Toledo Metropolitan Area Council of Governments (TMACOG) is the recognized transportation planning agency for the Toledo area including the proposed Maumee Bay State Park.

2\. As was pointed out in your document (page 7), the Ohio Department of Natural Resources (ODNR) had prepared the report Access Road Study for Maumee Bay State Park. TMACOG did not concur in the recommendation made in this report. An ad hoc committee was created to work with ODNR on highway access to the new state park. This committee included representatives of the City of Toledo, the City of Oregon, Lucas County, the Ohio Department of Transportation, the Toledo-Lucas County Plan Commissions, and Jerusalem Township. In summary, it can be stated that they did not concur with the recommendations of ODNR and recommended an alternate highway route. This is documented in an appendix to the above noted report which we would hope that the Corps has.

3\. Although this does not directly effect the study undertaken by the Corps, the development of a beach at the park will be the major traffic generator. TMACOG and the local units of government effected do not think that this issue has been adequately addressed.

Thank you for this opportunity.

Sincerely,

William L. Knight

William L. Knight, AICP
Director of Transportation Planning

mg

CC: Mr. Edwin R. Wyrick, Deputy Director
Ohio Department of Transportation - District Two

(419) 241-9155

CORPS RESPONSES TO TOLEDO METROPOLITAN AREA COUNCIL OF GOVERNMENTS
(Letter dated 24 May 1982)

1\. The statements on pages 41 and 44 have been revised.

2\. ODNR has been contacted in an effort to resolve this conflict. ODNR will reevaluate the conclusions of the Access Road Study to determine if the situation has changed. Further refinement of the access roads to be improved will be coordinated with local planning and governmental agencies, including TMACOG.

3\. The assessment of impacts on transportation (p. EIS-44) has been expanded.

P1)

United States Department of Agriculture

Soil Conservation Service

200 North High Street
Room 522
Columbus, Ohio 43215

May 24, 1982

Colonel George P. Johnson
District Engineer
Buffalo District, U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

The Draft Final Feasibility Report and Draft E.I.S. for Maumee State Park was sent to the USDA, Soil Conservation Service, Columbus, Ohio, for review and comment. We submit the following comments:

1 The soils on this site, Latty and Toledo, are classified as prime farmland if adequately drained for farming. This site was farmed prior to purchase by the State of Ohio.

2. There are several surface drainage ditches through this site that serve as outlets for agricultural drainage systems on private property adjoining the site. There is concern on the part of local people and local goverment officials (Lucas Soil and Water Conservation District) that these ditches be properly maintained by the State of Ohio.

3. Finally the soils on the site, Latty and Toledo are rated as severe for all recreational development uses due primarily to severe wetness and clayey conditions. Attached is Table 12 of the Lucas County Soil Survey, which lists suitability of soils for recreational development.

We appreciate the opportunity to review and comment on this project.

Sincerely,

Robert R. Shaw
State Conservationist

CORPS RESPONSES TO U.S. SOIL CONSERVATION SERVICE
(Letter dated 24 May 1982)

1. Pages 17 and 37 of the Main Report and page EIS-42 have been revised to reflect this soil classification.

2. On 8 July 1982, ODNR was contacted with respect to the maintenance of drainage ditches within the park and has acknowledged their responsibility for keeping them operable "in order to prevent flooding upstream and to protect ODNR development and interests."

3. Soil conditions will be taken into account in the final design of the proposed project.

Advisory Council On Historic Preservation

1522 K Street, NW
Washington, DC 20005

CORPS RESPONSE TO ADVISORY COUNCIL ON HISTORIC PRESERVATION
(Letter dated 10 May 1982)

May 11, 1982

Colonel George P. Johnson
District Engineer
Buffalo District
Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Dear Colonel Johnson:

1. We have reviewed the draft environmental impact statement (DEIS) and draft final feasibility report for shoreline protection and beach restoration at Maumee Bay State Park, Lucas County, Ohio. Since the two archeological sites identified and evaluated by archeological field survey and testing have been determined ineligible for the National Register of Historic Places, we have no objection to your determination that the proposed project would have no effect on significant historic or archeological properties under the National Environmental Policy Act, Section 106 of the National Historic Preservation Act, and the Council's regulatons (36 CFR Part 800).

Thank you for the opportunity to comment. If you have questions, please contact Ronald D. Anzalone, Staff Archeologist, at FTS 254-3974.

Sincerely,

(for) Jordan E. Tannenbaum
Chief, Eastern Division of
Project Review

1. Comment noted.

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (dpl)
Ninth Coast Guard District
1240 East 9th St.
Cleveland, Ohio 44199
(216) 522-4435

16475 MAY 10 1982

District Engineer
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara St.
Buffalo, New York 14207

Re: Your ltr NCBPD-ER dated 28 April 1982
concerning Maumee Bay State Park
Draft Final Feasibility Report and
Draft Environmental Impact Statement

Dear Sir:

1. The Ninth Coast Guard District has reviewed the referenced Draft Final Feasibility Report and Draft Environmental Impact Statement and we have no comments or objections to offer at this time.

Sincerely,

R. D. PETERSON
Commander, U. S. Coast Guard
District Planning Officer
By direction of the Commander,
Ninth Coast Guard District

CORPS RESPONSE TO U.S. COAST GUARD
(Letter dated 10 May 1982)

1. Comment noted.

SUPPLEMENTAL INFORMATION REPORT
TO
MAUMEE BAY STATE PARK, OH
SHORELINE EROSION/BEACH RESTORATION
FINAL FEASIBILITY REPORT

Appendix K

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

17 November 1983

Supplemental Information Report
to
Maumee Bay State Park, OH
Shoreline Erosion and Beach Restoration Final Feasibility Report

INTRODUCTION

The purpose of this Supplemental Information Report to the Maumee Bay State Park, Ohio, Shoreline Erosion and Beach Restoration - Final Feasibility Report (September 1982, revised June 1983) is to provide the results of reformulation and optimization studies that have been performed subsequent to completion of the September 1982 report. The need to perform these analyses resulted from the determination that discrete features of the Federal project - i.e., the proposed shoreline revetment along the eastern half of the park, and the protective beach along the western portion - must be incrementally justified, and the optimal beach size must be identified. Neither of these analyses were performed for the September 1982 Final Feasibility Report.

In addition, the need to modify the methodologies used in the economic analysis of recreations benefits and to expand upon the discussion of these methodologies have been identified. The method has been revised for this Supplemental Report, and the expanded discussion is provided herein.

OPTIMIZATION OF THE PROTECTIVE BEACH

Introduction.

The purpose of this optimization analysis is to evaluate a range of beach configurations "with" and "without" offshore segmented breakwaters, and of varying widths and lengths to identify the NED beach configuration. For the analysis, the beach lengths selected were 2,500 feet, 3,000 feet, 4,000 feet, and 5,500 feet. The 2,500-foot lower limit was selected because a beach of this length would only satisfy from about 30 percent to 55 percent of the recreational beach demand, dependent upon beach width. The 5,500-foot upper limit was established because a longer beach would be inconsistent with the State's park development plan. Initially, the beach width was varied from 100 feet to 250 feet, in increments of 50 feet. This resulted in 32 alternative beach configurations for the "without" breakwaters (Option 2b) and the "with" breakwaters (Options 3c) options, as shown in Table 1. Subsequent analysis showed that "net benefits" were not maximized for the 250-foot width, so beach widths of 300 feet and 350 feet were added for the 5,500 beach length.

Table 1 - Alternative Beach Configurations

Beach Dimensions			Alternative Designation	
Width (feet)	Length (feet)	Beach Area (sq. ft.)	Option 2b Without Breakwaters	Option 3c With Breakwaters
100	2,500	250,000	2b(100-2,500)	3c(100-2,500)
100	3,000	300,000	2b(100-3,000)	3c(100-3,000)
100	4,000	400,000	2b(100-4,000)	3c(100-4,000)
100	5,500	550,000	2b(100-5,500)	3c(100-5,500)
150	2,500	375,000	2b(150-2,500)	3c(150-2,500)
150	3,000	450,000	2b(150-3,000)	3c(150-3,000)
150	4,000	600,000	2b(150-4,000)	3c(150-4,000)
150	5,500	825,000	2b(150-5,500)	3c(150-5,500)
200	2,500	500,000	2b(200-2,500)	3c(200-2,500)
200	3,000	600,000	2b(200-3,000)	3c(200-3,000)
200	4,000	800,000	2b(200-4,000)	3c(200-4,000)
200	5,500	1,100,000	2b(200-5,500)	3c(200-5,500)
250	2,500	625,000	2b(250-2,500)	3c(250-2,500)
250	3,000	750,000	2b(250-3,000)	3c(250-3,000)
250	4,000	1,000,000	2b(250-4,000)	3c(250-4,000)
250	5,500	1,375,000	2b(250-5,500)	3c(250-5,500)
300	5,500	1,650,000	2b(300-5,500)	3c(300-5,500)
350	5,500	1,925,000	2b(350-5,500)	3c(350-5,500)

Determination of Beach Profiles, Quantities, and Periodic Nourishment Requirements for "With" (Option 3c) and "Without" (Option 2b) Breakwaters.

Background - The design of a sand beach is not an exact science due primarily to the unknown and/or unquantified forces that will impinge upon it. It's response to coastal processes is extremely difficult to predict and is the function of at least a dozen variables. Maumee Bay lies in a section of Lake Erie that exhibits many oddities in terms of coastal processes which makes designing a stable sand beach in this area even more of a challenge.

In many areas on the Great Lakes nearby beaches can be used as an aid to determine what might be expected. However, Maumee Bay is a unique area that must be treated independently. For example, the bay has the highest erosion rate in the Buffalo District averaging 15-20 ft./yr. It experiences the highest fluctuation in water levels. There is very little data on wave and current information. One of the most perplexing characteristics is that there is essentially no native sand to allow monitoring of its movement.

On the other hand, the area is semi-protected by Little Cedar Point which diffracts some of the wave energy. The offshore bathymetry is also very flat which limits the size of incoming waves.

As an aid to help better understand the coastal processes in Maumee Bay, two different types of littoral tests were performed. As stated in the FFR, even these tests gave little additional information and provided little support in predicting the stability of an unprotected beach.

All of these variables point to the fact that the stability of a placed sand beach without breakwaters (Option 2b) whose design is primarily based on experience and intuitive engineering judgement is questionable.

As shown later, the annual charges for the "without" breakwaters (Option 2b) alternative are highly influenced by the predicted nourishment and backpassing requirements. Although these quantities may appear conservative, particularly for the narrower beaches, the District feels they are reasonable considering the wave characteristics in the bay, the severe rates of erosion that do exist, and the uncertainty of the effects of the coastal processes on an exposed, protuding sand beach in this particular environment. Conversely, past experience and success with the offshore breakwater concept in the District instills a high degree of confidence in its success at Maumee Bay State Park. The use of offshore breakwaters as a supplemental means of shore protection on Lake Erie is believed to be a strong and positive alternative, and cost effective. The District has collected considerable data to support the functionality of this concept.

Analysis of Multiple Beach Widths and Lengths for Options 2b and 3c - As an analysis to determine what might be an optimum beach size in terms of initial costs, nourishment costs and backpassing costs, Options 2b and 3c were analyzed for multiple size beaches. Beach widths were varied between 100 feet and 250 feet (subsequently increased to 350 feet) and beach lengths

were varied between 2,500 and 5,500 feet. Cross sections of the various beach profiles, sandfill quantities nourishment rates and backpassing rates were obtained for this combination of beach configurations. The initial fill, nourishment and backpassing quantities are listed in Table 2. Even though the values are only estimates it is believed this process is a useful tool in optimizing the beach size. Supporting logic is as follows:

a. Beach Positions. The position of the beach with respect to the shoreline was selected so as to conform to the natural shoreline in order to minimize the quantities of placed sandfill. The beaches were positioned as far shoreward as possible, but only far enough to provide adequate sand at normal swimming depths.

b. Beach Fill Quantities and Compositions. Sand to be used in the beaches is proposed to be of a medium to fine grain size because of its availability and cost. Sand would likely be mined from an offshore site in the vicinity of Maumee Bay. Quantities were determined based on the cross sections, and were incrementally varied according to the respective beach length.

c. Crest Elevations. Beach crest elevations in the back beach area were set at +10 LWD for all plans because Maumee Bay frequently experiences lake levels and wave runup combinations that approach this elevation. A 10-year recurrence water level with a mild storm condition would likely reach this level. Lower crest elevations would provide little savings and would jeopardize the stability of the beach due to inland overwash.

d. Beach Berms and Slopes. Beach berms were set to provide the desired beach width and slopes were set in accordance with slopes of other Lake Erie beaches. The foreshore slope was set at 1 vertical to 12 horizontal and the underwater water beach slope was set at 1V to 20H.

e. Nourishment Rates. Nourishment rates are the most difficult to ascertain as a result of the numerous uncertainties associated with Maumee Bay coastal processes. This is especially true for the various alternatives of Option 2b, which have no other supplemental protection as the Option 3c alternatives have. Rather than assuming a percentage as is often done, it is believed more accurate nourishment rates for the Option 2b alternatives could be based on current erosion losses. This was done for the 350 feet, 300 feet, 250 feet, and 200 feet wide beaches (5,500-foot length) which indicate annual nourishment rates of 20,000 c.y./yr. Shorter beach lengths have incrementally lower nourishment rates. As shown in Table 2, beach widths of 150 feet and 100 feet have considerably higher nourishment rates. This is due to the belief that the 150-foot wide beach would experience one to two storms per year that would remove enough sand to expose and erode the vegetated dune and hence cause an unraveling of the entire beach in the form of inland sand transport. A similar type process would occur for the 100-foot wide beach

Table 2 - Estimated Initial Fill, Nourishment, and Backpassing Quantities for Options 2b and 3c

Option/ Beach Width	Beach Length, Feet			
	2,500	3,000	4,000	5,500
Option 2b (Without Breakwater)	(cubic yards)	(cubic yards)	(cubic yards)	(cubic yards)
W = 350 feet				Q = 340,000 B = 25,000 N = 20,000
W = 300 feet				Q = 310,000 B = 25,000 N = 20,000
W = 250 feet	Q = 130,000 B = 12,000 N = 9,000	Q = 155,000 B = 14,000 N = 11,000	Q = 205,000 B = 18,000 N = 15,000	Q = 280,000 B = 25,000 N = 20,000
W = 200 feet	Q = 115,000 B = 12,000 N = 9,000	Q = 140,000 B = 14,000 N = 11,000	Q = 180,000 B = 18,000 N = 15,000	Q = 250,000 B = 25,000 N = 20,000
W = 150 feet	Q = 60,000 B = 9,000 N = 34,000	Q = 70,000 B = 14,000 N = 40,000	Q = 95,000 B = 18,000 N = 55,000	Q = 130,000 B = 25,000 N = 75,000
W = 100 feet	Q = 40,000 B = 9,000 N = 45,000	Q = 46,000 B = 11,000 N = 55,000	Q = 62,000 B = 15,000 N = 73,000	Q = 85,000 B = 20,000 N = 100,000
Option 3c (With Breakwaters)				
W = 350 feet				Q = 270,000 B = 0 N = 5,000
W = 300 feet				Q = 235,000 B = 0 N = 5,000
W = 250 feet	Q = 90,000 B = 0 N = 2,000	Q = 110,000 B = 0 N = 3,000	Q = 145,000 B = 0 N = 4,000	Q = 200,000 B = 0 N = 5,000
W = 200 feet	Q = 75,000 B = 0 N = 2,000	Q = 90,000 B = 0 N = 3,000	Q = 120,000 B = 0 N = 4,000	Q = 165,000 B = 0 N = 5,000
W = 150 feet	Q = 60,000 B = 0 N = 2,000	Q = 70,000 B = 0 N = 3,000	Q = 95,000 B = 0 N = 4,000	Q = 130,000 B = 0 N = 5,000
W = 100 feet	Q = 40,000 B = 16,000 N = 4,000	Q = 46,000 B = 19,000 N = 5,000	Q = 62,000 B = 25,000 N = 7,000	Q = 85,000 B = 35,000 N = 10,000

W = Beach Width (feet)
Q = Initial Beach Fill Quantity (cubic yards)
B = Backpassing Quantity/Year (cubic yards/year)
N = Annual Nourishment (cubic yards/year)

except it would occur more frequently. This type of failure must be anticipated when considering beaches of these widths. For the shorter length beaches nourishment rates were again incrementally lowered.

Nourishment rates for the Option 3c alternatives are considerably lower due to the protection afforded by the offshore breakwaters. For these plans, the breakwaters were considered to be 75 percent effective in reducing nourishment rates (5,000 yards/year) for all but the 100-foot beach width. For the 100-foot beach width, it is believed the breakwaters would cause scalloping of the beach to the degree that the vegetated dune would again be exposed and eroded causing significant sand losses. For this case, a nourishment rate of 10,000 yards/year was used. For shorter beach lengths, nourishment rates were again incrementally lowered as shown in Table 2.

f. Backpassing Rates. Backpassing rates are based on the little known information of littoral currents inside Maumee Bay and on the average of transport rates for other Lake Erie sites. The predominant drift is from east to west, and for the 350 feet, 300 feet, 250 feet, and 200 feet wide beaches without breakwaters (5,500-foot length), the backpassing rate was assumed to be 25,000 cubic yards/year. For the narrower 150-foot and 100-foot wide beaches (5,500 length), a smaller supply of sand is available, therefore, the backpassing rates were lowered to 20,000 cubic yards/year. For shorter beach lengths (without breakwaters) backpassing rates were incrementally lowered as shown in Table 2.

For the Alternative 3c plans, the breakwaters should effectively halt any longshore transport. For all of the Option 3c plans except the 100-foot wide beach, the backpassing rates were set at 0. For the 100-foot width, it was concluded that the sand accreting in the lee of the breakwaters would be moved back to narrow beach areas at the breakwater gaps as an alternative to the more costly nourishment. These estimated quantities are identified as backpassing in Table 2.

Cost-Sharing of Beach Nourishment Costs - Current guidance, contained in paragraph 4-2 of ER1105-2-20 (RRAP), states in part that . . . "Periodic nourishment is considered construction for cost sharing purposes when in the opinion of the CDR USACE, such periodic nourishment is found to be a more economical erosion protection measure." For Maumee Bay State Park, the beach is a partial alternative to a continuous revetment and the beach is desired by the State to achieve beach use benefits. Projects recommending periodic nourishment should not, however, include structures which materially reduce littoral drift from reaching downdrift shores. At Maumee Bay State Park, the existing net littoral drift is estimated at 5,000 cubic yards annually. As shown in Table 2, nourishment quantities (offshore-downdrift losses) equal or exceed this value for the "with" and "without" breakwater options. The Maumee Bay jetties and detached offshore breakwaters should not reduce littoral drift because the beach is recessed from the shoreline and can be categorized as a pocket beach, and because there is little naturally occurring sand size material at the site, in all likelyhood there will be an increase in littoral material reaching adjacent shores with the beach project.

Therefore, the Maumee Bay State Park project periodic nourishment is considered "construction" for cost-sharing purposes. Further, as discussed and agreed to at the recent project review conference, the nourishment will be cost-shared for the life of the project. Based on the traditional apportionment of costs, the periodic nourishment will be cost-shared 70 percent Federal and 30 percent non-Federal for either the "with" breakwaters or "without" breakwaters options.

Cost Estimates for Beach Options 2b (Without Breakwaters) and 3c (With Breakwaters).

First Cost - Cost estimates were prepared for the various beach configurations under Options 2b and 3c at February 1983 price levels. Standard construction items incorporated into the cost estimates are:

Option 2b (without breakwaters)

Initial Beach Fill
Excavation (250-foot wide beach)
Ditch Relocations (4,000 - 5,500 feet beach)
East and West Jetties
Lands

Option 3c (with breakwaters)

Initial Beach Fill
Excavation (200 - 300 feet wide beach)
Ditch Relocation (4,000 - 5,500 feet beach)
East and West Jetties
Lands
Offshore Breakwaters
Aids to Navigation

Total project first costs for each of the alternatives under Options 2b and 3c are shown in Table 3, following.

In addition to the costs for the Federal project, there are certain associated ODNR park development costs that are allocable to the project. For the beach project, these associated costs are for the bathhouse, parking for the beach, picnic areas, and lands for these facilities. The total associated ODNR costs are $5.82 million.

Annual Charges - The annual charges for each of the alternative beach configurations considered, at 7-7/8 percent interest date and 50-year project life, are also summarized in Table 3. As shown in the table, the total Federal Project annual charges are added to the annual charges of $678,000 for the associated ODNR development to obtain the total annual charges allocable to the shoreline protection/beach project.

Economic Analysis for the Protective Beach Feature.

Introduction - Maumee Bay State Park is located in Lucas County, OH. The park is located approximately 5 miles east of Toledo, OH. The Toledo SMSA had a population of 792,000 in 1980. Plate 1 shows the development's vicinity and location. The 1,855-acre park will provide opportunities for camping, picnicking, hiking, and fishing under current plans of continued development. However, if a beach erosion project is implemented, Ohio Department of Natural Resources will significantly expand development of the

Table 3 - First Cost and Annual Charges for Beach Options 2B and 3C (February 1983 Price Levels)

No. (1)	Alternative: Beach Width	Alternative: Beach Length	Project First Cost	Federal Project Annual Charges: Interest and Amortization (2)	Nourishment and Backpassing and Monitoring	Maintenance of Structures	Total Federal Project Annual Charges	Total Annual Charges, Federal Project and ODNR Development (3) (4)
			$	$	$	$	$	$
Option 2b - Without Breakwater								
2B	350	5,500	7,067,000	631,000	292,000	80,000	1,003,000	1,953,500
2B	300	5,500	6,452,000	559,000	292,000	80,000	931,000	1,745,700
2B	250	5,500	5,656,000	491,800	292,000	75,000	858,800	1,537,700
2B	250	4,000	4,324,000	376,000	221,000	75,000	672,000	1,350,900
2B	250	3,000	4,255,000	370,000	170,600	65,000	605,600	1,284,500
2B	250	2,500	3,210,000	279,100	145,000	60,000	484,100	1,163,000
2B	200	5,500	5,230,000	454,800	292,000	75,000	821,800	1,500,700
2B	200	4,000	3,796,000	330,100	221,000	75,000	626,100	1,305,000
2B	200	3,000	3,380,000	293,900	170,600	65,000	529,500	1,208,400
2B	200	2,500	3,006,000	261,000	145,000	60,000	466,000	1,444,900
2B	150	5,500	3,265,000	283,900	745,000	75,000	1,103,900	1,782,800
2B	150	4,000	2,885,000	250,900	553,000	75,000	878,900	1,557,800
2B	150	3,000	2,447,000	212,800	408,000	65,000	685,800	1,364,700
2B	150	2,500	2,265,000	197,000	348,400	60,000	605,400	1,284,300
2B	100	5,500	2,520,000	219,100	960,000	75,000	1,254,100	1,924,000
2B	100	4,000	2,338,000	203,300	707,800	75,000	986,100	1,665,000
2B	100	3,000	2,021,000	176,000	537,000	65,000	778,000	1,456,900
2B	100	2,500	1,905,000	165,600	443,000	60,000	668,000	1,346,900
Option 3c - With Breakwater								
3C	350	5,500	8,312,000	722,800	63,000	155,000	940,800	1,891,300 (5)
3C	300	5,500	7,753,000	674,200	63,000	155,000	892,200	1,706,900 (5)
3C	250	5,500	7,236,000	629,200	63,000	151,000	843,200	1,522,100
3C	250	4,000	5,477,000	476,000	55,000	130,000	661,000	1,339,900
3C	250	3,000	4,409,000	383,400	46,000	106,000	535,000	1,214,300
3C	250	2,500	4,000,000	348,000	37,000	98,000	483,000	1,116,900
3C	200	5,500	6,588,000	572,900	63,000	151,000	786,900	1,465,800
3C	200	4,000	5,146,000	447,000	55,000	130,000	632,000	1,310,900
3C	200	3,000	4,156,000	361,000	46,000	106,000	513,000	1,191,900
3C	200	2,500	3,741,000	325,000	37,000	98,000	460,000	1,138,900
3C	150	5,500	5,816,000	506,000	63,000	151,000	720,000	1,398,900
3C	150	4,000	4,793,000	417,000	55,000	130,000	602,000	1,280,900
3C	150	3,000	3,873,000	337,000	46,000	106,000	489,000	1,167,900
3C	150	2,500	3,210,000	279,000	37,000	98,000	414,000	1,092,900
3C	100	5,500	5,201,000	452,000	246,000	151,000	849,000	1,527,900
3C	100	4,000	4,337,000	377,000	180,000	130,000	687,000	1,365,900
3C	100	3,000	3,534,000	307,000	139,000	106,000	552,000	1,230,900
3C	100	2,500	3,291,000	286,000	118,000	98,000	502,000	1,180,900

(1) Option 2B - without breakwaters, Option 3C - with breakwaters.
(2) 50-year project life, 7-7/8 percent interest rate.
(3) Associated ODNR first cost = $5,820,000 for bathhouse, parking for beach, picnic area, and lands.
(4) Associated ODNR development annual cost = $678,900.
(5) For 350-foot wide beach, ODNR development cost = $8.1 million; annual charges = $950,500.

park. The expanded park would include a bathing beach, bathhouse, expanded picnicking and fishing facilities, cabins, a lodge, and a golf course, in addition to the facilities already being developed.

The economic evaluation of the proposed project alternatives is based on the increased recreational value directly provided by the implementation of the beach erosion control measure. Activities directly associated with the proposed alternatives include beach use (swimming, sunbathing) and jetty fishing. Though the implementation of Federal shore protection would induce additional park development, the recreational values asssociated with those activities (other than beach use and jetty fishing) are not considered primary nor used for project justification. Three benefit categories were determined and evaluated in the analysis: recreational beach use, recreational fishing, and land loss prevention. The recreational benefit evaluation was accomplished using the travel cost method (TCM). This method was applied to a site specific study using the similar project technique to estimate future recreational usage at Maumee Bay State Park.

Thirty-six alternative plans of improvement were analyzed in an attempt to maximize net national economic development (NED) benefits. They are comprised of eighteen combinations of beach width and length combinations with and without segmented breakwaters. Additionally, a no-action alternative was evaluated and is used as the base case.

Total benefits associated with each of the thirty-six alternatives are calculated as the difference in the total value directly provided by each alternative plan of improvement and the total value provided by the base case.

Recreational Use Estimation - East Harbor State Park (EHSP) was selected as the similar site for determining the recreational usage of Maumee Bay State Park. EHSP is located on Lake Erie, 81 miles west of Cleveland and 45 miles east of Toledo (Plate 2). The 1,613-acre park offers a wide range of resource attributes including access to Lake Erie for swimming and fishing. EHSP was selected among all other Ohio State Parks based on similar park characteristics including type, size, and quality of the park as well as market area demographic and socioeconomic characteristics; and location of competing recreational opportunities.

The historic East Harbor State Park visitation data were analysized to determine user preferences and characteristics. The types of activities available and EHSP's estimate of use by activity were crucial inputs to the demand analysis of Maumee Bay. The travel cost method also requires visitor origin data; however, this was not available for EHSP. The origin or travel distance data is crucial in estimating the first stage demand curve in the TCM. Recreation day use visitor origin data, however, was available in a 1977 Pennsylvania Department of Environmental Resources study.

Travel Distance Decay Function - The demand for beach recreation is significantly affected by the time/distance the population served is willing to travel to engage in beach activities. Generally, as the time/distance function increases, the per capita participation rate decreases. This is due to availability of alternative beaches, alternative recreation activities,

and travel and time restrictions. Several State Comprehensive Outdoor Recreation Plans (SCORP) were reviewed to determine the travel distance decay function most applicable to East Harbor State Park, Ohio. East Harbor State Park was used as a similiar park for evaluation of the Maumee Bay study. The Ohio SCORP did not present travel distance per capita data. However, the Pennsylvania SCORP did present the findings of their study of seven state parks. The percent distribution of day use visitors by zone was presented in the 1977 summer recreation origin survey.

The socio-economic patterns of Ohio and Pennsylvania were compared to ensure the Pennsylvania results were appropriate for use in Ohio. Since recreation preferences are strongly associated with socio-economic characteristics, a close parallel of Ohio and Pennsylvania socio-economic patterns would support application of Pennsylvania data to the East Harbor similar park.

Ohio and Pennsylvania are adjacent, heavily industrialized, states with approximately the same population and total area. Ohio had a 1980 population of 10.8 million and area of 41,330 square miles, while Pennsylvania has 11.9 and 45,308, respectively. In addition, the water areas, as defined in the 1982-83 Statistical Abstract of the United States, Table No. 338, Area of States and Other Areas: 1980, are 325 square miles for Ohio and 420 square miles for Pennslyvania. Overall, the states are very similar, as shown in the following comparison.

Four dominant socio-economic factors in determining recreation preferences were compared. The four factors were population, employment, income, and education. A demographic profile of each state is presented in Table 4, 1980 Population Characteristics for Ohio and Pennsylvania. There is less than 9 percent difference in population, and perhaps more importantly, only a 4 percent difference in population under 45 years of age. Recreation participation rates generally decline rapidly in higher age cohorts. In addition, the states are very similiar in sex, race, and household characteristics.

Employment and labor force characteristics are also similar for 1981. Employment is strongly oriented toward manufacturing in comparison with the employment in manufacturing nationally. Pennsylvania and Ohio have 28 percent and 29 percent of their labor force employed in manufacturing, while only 22 percent of the national labor force is employed in this area. The total (number of people in the) labor force is very comparable as are the employment population ratios and participation rates for males and females. Table 5 shows employment distribution by industry and total labor force data for each state.

Family income characteristics for the two states were found to be approximately the same. Median family incomes were 2 percent apart in 1979; with Ohio ranking 16th among the states and Pennsylvania 21st. The percent distribution of families among income groups was also very similar. Income characteristics were more similar to each other than they were U.S. data. See Table 6 for Family Income Characteristics.

The education enrollment for 1980 and the years of completed schooling among persons 25 years and older (in Ohio and Pennsylvania) closely parallel to each other as shown in Table 7. Each state has approximately the same enrollment in elementary, secondary, and higher institution. In addition, the educational status of people over 25 reflects similar attitudes and preferences. Approximately 67 percent of Ohio population over 25 completed high school and 15 percent completed college. Similar data for Pennsylvania was 65 percent and 14 percent as of 1980.

In summary, there are close parallels in Ohio and Pennsylvania socio-economic characteristics. The four broad areas compared strongly influence recreation activity preferences in the population. Since the dominant characteristics of Pennsylvania and Ohio are very similar, both absolutely and relatively, the results of the Pennsylvania study were considered more representative of Ohio recreation patterns than general curves based on national data. Also, the states are adjacent and have similar highway networks. These factors resulted in the conclusion Pennsylvania percent distribution of that day use visitors by origin zone is appropriate for use in the Maumee Bay study.

Table 4 - 1980 Population Characteristics for Ohio and Pennsylvania

	U.S.	Ohio	Pennsylvania
Population - 1980		10,748,000	11,864,000
Median Age		29.9	32.1
Population Under 44		6,645,000	6,945,000
Population by Sex, Race, Spanish Origin			
White			
Male		4,650,000	5,117,000
Female		4,948,000	5,535,000
Black			
Male		506,000	484,000
Female		571,000	563,000
Spanish			
Male		60,000	77,000
Female		60,000	77,000
Households 1980			
Number (000)		3,834	4,220
Persons in Hshlds (000)		10,569	11,566
Persons per Hshld		2.76	2.74

Table 5 - 1981 Employment and Labor Force Characteristics

	U.S.		Ohio		Pennsylvania	
Labor Force, Employment (in 000's)						
Total Labor Force	108,670		5,085		5,476	
Employed	100,397		4,595		5,018	
Employ Population Ratio	58.3		57.4		55.2	
Participation Rate						
Male	77.0		77.9		74.7	
Female	52.1		50.5		47.5	
Nonagricultural Employment (000's)						
Total	91,105	%	4,323	%	4,724	%
MFG	20,173	22	1,233	29	1,300	28
Trade	20,551	23	946	22	986	21
Gov't	16,024	18	680	16	705	15
Services	18,592	20	856	20	1,006	21
Transportation, Utilities	5,157	6	218	5	258	5
Finance	5,301	6	205	5	241	5
Construction	4,176	5	154	4	183	4

Table 6 - Family Income Distribution (1979)

	U.S.	Ohio	Pennsylvania
Percent Distribution			
Under 10,000	20.5	17.8	17.9
10,000 - 24,999	44.1	45.2	46.8
25,000 - 34,999	19.2	20.9	20.6
35,000 - 49,999	10.6	11.4	10.1
50,000 or more	5.6	4.7	4.6
Number of Families (000)	58,976	2,858	3,138
Median Family Income	$19,908	$20,710	$20,259
State Rank in Family Income	(X)	16	21

Table 7 - Education Characteristics (in thousands)

Education	Ohio		Pennsylvania	
Enrollment: 1980				
Elementary (000)	1,493		1,486	
Secondary (000)	708		771	
Higher (000)	489		507	
Years of School Completed (1)				
Population (000)	6,290	%	7,239	%
Years Completed				
Elementary (000)	944	100	1,319	100
High School (000)	2,488	67	2,895	65
College	932	15	996	14
Public				
Private				

(1) Persons 25 years old and older.

Beach Use - The recreation demand at Maumee Bay is based on per capita use rates developed for various distances from the park site. Per capita use rates were used to develop total beach visitation from each zone and eventually, by adjusting for the average number of occupants per vehicle, in estimating the number of vehicle trips from each distance zone. County Census population data for 1980 were used to develop the population in each of eight zones 25 miles wide around East Harbor State Park. This is the first step in the analysis for determining per capita trip rates for swimming. A 200-mile radius was established as a reasonable maximum travel distance for this analysis based on park survey data for people engaging in day use activities. Road mileage distances were measured from the centroid of each county within the 200-mile radius.

The second step in deriving beach use per capita trip rates is by distributing EHSP swimming attendance by distance zone. This is accomplished by multiplying historical attendance for swimming by the percentage distribution of day use attendance origin for each 25-mile distance zone. Swimming attendance is based on the 1980 historical attendance of East Harbor State Park.

The percentage distribution of recreation trip origins by zone is shown on Table 8. The distribution of park visitor trips by origin zone is based on a 1977 summer origin survey conducted by the Pennsylvania Department of Environmental Resources. The seven Pennsylvania State parks included in the origin survey are primarily day use parks having the same available recreation activities as Maumee Bay State Park. Estimated vehicle trips by distance zone is calculated by dividing the historical 1980 swimming attendance for each distance zone by the average occupants per car (3.5). Dividing estimated vehicle trips by the total population for each zone yields per capita trip rates by distance zone. This relationship is then multiplied by

the eight 25-mile wide distance population zones constructed around Maumee Bay State Park to calculate an estimate for swimming demand at Maumee Bay State Park (Table 9). Beach demand by decade for the 50-year project evaluation period (1990-2040) is based on the projected population multiplied by the per capita trip rates. The decadal 1990-2040 projections for the eight zones surrounding Maumee Bay State Park are shown in Table 10. The population projection series was based on State and county level projections. The average annual population growth rate for the period covered in the county projections developed by the several States were used to extrapolate population projections for the entire project evaluation period. The counties within the 200-mile radius are presented by State and zone in Table 11.

Demand Verification - The results of the swimming demand analysis were evaluated for reason-ableness in a regional framework. Composite demand estimates from adjacent SCORP studies were reviewed to ensure State level demand estimates were compatible with Maumee Bay study results. In addition, historical visitation data for East Harbor State Park were reviewed. East Harbor State Park was the similar park whose visitation patterns served as the basis for the Maumee Bay demand analysis.

The SCORP studies for Ohio, Indiana, and Michigan were reviewed since most of the Maumee Bay visitation was expected to originate from these areas. Canadian provincial recreation demand studies were not available. The SCORP data were not additive because of conceptual and technical differences in the state studies. However, significant swimming needs, especially a natural environment swimming, were found to exist over the planning evaluation period. For example, the 1980 gross needed capacity for Ohio planning regions was 14,300,000. Thus, the Ohio SCORP estimated that 14,300,000 people occasions demanding swimming could not be net because of constrained capacity. The Ohio calculations included pool as well as a natural environment swimming.

The Indiana SCORP indicated that there was a surplus in supply capacity from 1980 to 1990. However, by 1995 there would be a demand for 460,000 swimming occasions that could not be met because of limited supply.

The Michigan SCORP did not directly address the issue of excess demand or deficit supply. However, conversation with the Michigan Department of Natural Resources indicated that there is excess demand in that state.

Finally, East Harbor State Park historical park visitation was reviewed from data currently available. The historical data were significantly higher than the 352,000 beach attendance in 1980. The East Harbor State Park swimming beach was approximately 2 miles long originally. About 2 miles of stone revetment was constructed in the early 1960's for dune protection. During this time there was 150 feet of beach lakeward of the wall. The high lake level has inundated and eroded the beach back to the stone revetment and the former beach has been reduced to the form of offshore bars.

Table 8 - Per Capita Trips for Swimming, East Harbor State Park

(1) Zone	(2) Distance in Miles	(3) Percent Distribution of Day Use Visitors by Zone (1)	(4) Annual Day Use Visitors with Beach	(5) Total Part. by Zone (3) X (4)	(6) Average Occupancy Per Car	(7) Vehicle Trips (5) ÷ (6)	(8) Population by Zone	(9) Trips Per Capita (7) ÷ (8)
1	0-25	.514	352,964	181,423	3.5	51,835	79,741	.65005
2	26-50	.277	352,964	97,771	3.5	27,935	801,178	.03487
3	51-75	.049	352,964	17,295	3.5	4,941	2,472,318	.00200
4	76-100	.041	352,964	14,472	3.5	4,135	4,307,937	.00096
5	101-125	.04	352,964	14,119	3.5	4,034	4,361,719	.00092
6	126-150	.04	352,964	14,119	3.5	4,034	3,994,994	.00101
7	151-175	.024	352,964	8,471	3.5	2,420	1,682,544	.00144
8	176-200	.015	352,964	5,294	3.5	1,513	5,051,097	.00030

(1) SOURCE: 1977 Summer Recreation Origin Survey, Pennsylvania Department of Environmental Resources.

Table 9 - Maumee Bay State Park Swimming Demand by Decade

Zone Number	Zone in Miles	Swimming Demand						
		1980	1990	2000	2010	2020	2030	2040
1	0-25	1,473,920	1,545,845	1,618,131	1,709,194	1,815,534	1,939,872	2,085,458
2	25-50	55,405	60,036	63,907	69,300	75,317	82,033	89,551
3	50-75	23,020	23,748	23,345	23,163	23,174	23,398	23,846
4	75-100	14,424	14,872	15,036	15,316	15,722	16,258	16,919
5	100-125	7,851	8,712	9,527	10,577	11,813	13,262	14,973
6	125-150	16,293	17,192	18,295	19,425	20,682	22,099	23,695
7	150-175	15,278	16,405	17,234	18,617	20,227	22,110	24,049
8	175-200	4,221	4,494	4,736	5,079	5,499	6,027	6,682
Total		1,610,412	1,691,304	1,770,211	1,870,671	1,987,968	2,125,059	2,285,173

Table 10 - Population Projections by Zone, Around Maumee Bay State Park

Zone	Distance	1990	2000	2010	2020	2030	2040
1	0-25	679,444	711,216	751,240	797,980	852,630	916,620
2	26-50	491,958	523,665	567,880	617,170	672,220	733,830
3	51-75	3,394,276	3,336,714	3,310,620	3,312,320	3,343,950	3,408,160
4	76-100	4,425,762	4,475,042	4,558,190	4,679,500	4,838,500	5,035,590
5	101-125	2,690,314	2,942,245	3,266,810	3,648,110	4,096,650	4,624,420
6	126-150	4,863,807	5,175,720	5,494,640	5,850,770	6,251,360	6,702,790
7	151-175	3,259,621	3,423,944	3,698,838	4,018,620	4,393,155	4,778,408
8	176-200	4,294,063	4,524,552	4,853,432	5,252,860	5,759,400	6,383,960

Table 11 - Counties Surrounding Maumee Bay State Park by State, by Zone

Zone	Distance In Miles	Ohio	Michigan	Indiana	Pennsylvania	Canada
1	0-25	Lucas	Monroe	None	None	None
		Ottawa				
2	26-50	Fulton	Lenawee	None	None	None
		Hancock				
		Henry				
		Sandusky				
		Seneca				
		Wood				
3	51-75	Crawford	Hillsdale	None	None	None
		Defiance	Washtenaw			
		Erie	Wayne			
		Hardin				
		Huron				
		Lorain				
		Paulding				
		Putnam				
		Williams				
		Wyandot				
4	76-100	Allen	Jackson	Steuben	None	Essex
		Ashland	Livingston			
		Auglaize	Macomb			
		Cuyahoga	Oakland			
		Logan				
		Marian				
		Morrow				
		Richland				
		VanWert				
5	101-125	Champion	Branch	Allen	None	Kent
		Delaware	Eaton	Dekalb		
		Holmes	Ingham	LaGrange		
		Knox	Lapeer	Noble		
		Lake	Saint Clair			
		Medina				
		Mercer				
		Miami				
		Shelby				
		Summit				
		Union				
		Wayne				

Table 11 - Counties Surrounding Maumee Bay State Park
by State, by Zone (Cont'd)

Zone	Distance: In Miles	Ohio	Michigan	Indiana	Pennsylvania	Canada
6	126-150	Ashtabula	Barry	Adams	None	Lambton
		Clark	Calhoun	Blackford		
		Coshocton	Cass	Elkhart		
		Darke	Clinton	Huntington		
		Fayette	Genesee	Jay		
		Franklin	Ionia	Wells		
		Geauga	Kalamazoo	Whitley		
		Licking	Saint Joseph			
		Madison	Sanilac			
		Montgomery	Schiawassee			
		Muskingum	Tuscola			
		Portage				
		Stark				
		Trumbull				
		Tuscarawas				
7	151-175	Butler	Bay	Delaware	None	Middlesex
		Carroll	Gratiot	Kosciusko		
		Clinton	Huron	Miami		
		Fairfield	Kent	Saint Joseph		
		Greene	Midland	Wabash		
		Hocking	Montcalm			
		Mahoning	Saginaw			
		Morgan	VanBuren			
		Perry				
		Pickaway				
		Preble				
		Ross				
		Warren				
8	176-200	Adams	Allegan	Carroll	Beaver	Elgin
		Athens	Arenac	Cass	Crawford	
		Belmont	Berrien	Fulton	Erie	
		Brown	Clare	Grant	Lawrence	
		Clermont	Gladwin	Hamilton	Mercer	
		Columbiana	Isabella	Henry		
		Guernsy	Mecosta	Howard		
		Hamilton	Muskegon	Laporte		
		Harrison	Ottawa	Madison		
		Highland		Marshall		
		Jackson		Pulaski		
		Jefferson		Randolph		
		Meigs		Starke		
		Monroe		Tipton		
		Noble		Wayne		
		Pike				
		Vinton				

Prior to the high lake stages and severe beach erosion in the mid 1970's, beach attendance was significantly higher than in the recent past. The beach use for the year 1966-67 was 790,000. It must be noted that Ohio generated annual attendance on the basis of a fiscal year extending from 1 July to 30 June. The highest beach visitation level was reached in 1970-71 when 836,000 people attended the beach. Discussions with Park staff recently indicated that the highest single day attendance was approximately 65,000 before severe erosion greatly reduced the beach area.

During the late 1970's, 90 percent of the original beach was posted as unsafe. Swimming attendance dropped from 790,000 in 1966-67 to 634,000 in 1973-74 and to 240,000 in 1976-77. The only usable portion of the original beach was a relatively small area north of the revetment. Plate 2 indicates the original configuration of East Harbor State Park beach.

In summary, the demand developed in the Maumee Bay study appears very reasonable given SCORP data and information from several states. It also appears reasonable in terms of historic visitation at East Harbor State Park. Although 1980 beach attendance at East Harbor was only 42 percent of the 1970 attendance, it was the basis for developing Maumee Bay demand for beach visitation. Thus, the demand for beach opportunities at the Maumee Bay site appear very reliable.

Beach Attendance - Projected swimming demand presented in Table 9 is calculated based on an unconstrained beach size at Maumee Bay State Park. For each of the eighteen beach width and length combinations analyzed, the total annual expected beach attendance was calculated. 1980 historical daily attendance figures for swimming at EHSP were used to simulate the distribution of annual demand at Maumee Bay on a daily basis. The daily attendance was ranked from the highest use day to the least use day and the percentage distribution for the 122 day swimming season was calculated. These daily percentages were multiplied by the total annual swimming demand at Maumee Bay State Park to estimate daily swimming demand.

The daily capacity was calculated for the beach area for each alternative using a space standard of 100 square feet per person and a daily turnover rate of 1.5. Annual beach attendance for each alternative calculated as the sum of daily swimming demand. For those days where swimming demand was estimated as being greater than daily capacity, the smaller number is used in the sum. Maximum daily capacity and projected annual beach attendance by decade is presented in Table 12 for each alternative.

Recreational Valuation Methodology - Recreational values have been calculated for swimming. Total recreational value by alternative is calculated by summing up consumer surplus for motor vehicle costs and opportunity costs of onsite and driving time (via travel cost method) and user fee revenues ($0 in this case).

Table 12 - Projected Annual Attendance at Maumee Bay State Park Swimming Beach Alternatives (Options 2B and 3C)

Alternative		Beach	Daily	Projected Annual Beach Attendance						
Width	Length	Area	Capacity	1980	1990	2000	2010	2020	2030	2040
100	2,500	250,000	3,750	424,323	426,958	429,336	431,893	434,752	437,953	440,308
100	3,000	300,333	4,500	498,573	501,243	503,840	507,155	511,017	515,228	519,253
150	2,500	375,000	5,625	608,613	611,842	614,821	618,433	622,392	626,911	632,187
100	4,000	400,000	6,000	644,613	648,062	651,303	655,183	659,391	664,036	669,312
150	3,000	450,000	6,750	716,613	720,062	723,421	727,705	732,578	737,816	743,562
200	2,500	500,000	7,500	786,704	791,187	795,354	799,705	804,698	810,541	816,964
100	5,500	550,000	8,250	854,104	860,337	865,304	870,874	876,698	882,541	889,362
200	3,000	600,000	9,000	919,176	926,469	932,813	940,326	947,116	954,464	961,362
150	4,000	600,000	9,000	919,176	926,469	932,813	940,326	947,116	954,464	961,362
250	2,500	625,000	9,375	950,340	958,719	965,806	973,809	981,965	989,587	997,362
250	3,000	750,000	11,250	1,099,767	1,110,775	1,120,746	1,133,079	1,146,591	1,159,038	1,171,620
200	4,000	800,000	12,000	1,153,928	1,169,057	1,180,382	1,193,278	1,207,732	1,223,496	1,237,778
150	5,500	825,000	12,375	1,179,181	1,196,353	1,209,562	1,223,199	1,237,898	1,254,367	1,270,253
250	4,000	1,000,000	15,000	1,324,971	1,354,386	1,381,570	1,410,375	1,437,147	1,463,013	1,484,963
200	5,500	1,110,000	16,650	1,401,260	1,434,293	1,464,358	1,500,985	1,540,977	1,577,011	1,611,455
250	5,500	1,375,000	20,625	1,532,693	1,582,451	1,627,700	1,679,982	1,732,772	1,788,560	1,847,788
300	5,500	1,650,000	24,750	1,593,477	1,664,246	1,728,249	1,799,768	1,873,830	1,953,690	2,035,278
350	5,500	1,925,000	28,875	1,604,450	1,683,589	1,758,380	1,851,749	1,954,214	2,060,331	2,165,022

Recreational Values - Table 13 presents the resultant calculated second stage demand curve for hypothetical shifts in motor vehicle costs for 1990 unconstrained by supply. The area under each curve represents the motor vehicle cost portion of consumer surplus which partially comprises the total recreational value of each alternative with no supply constraint. The average value per visit is calculated as the total area under the second stage demand curve (above actual travel cost expenditures) divided by the estimated number of annual visits (demand) with a zero distance shift ($2,140,350 - 483,229). Because the annual demand estimate is greater than the annual supply provided under each alternative, the recreational value for motor vehicle costs is calculated as the product of average value per visit and the annual attendance (trips) with supply constraint. Table 14 provides the recreational value for motor vehicle costs in 1990 for each alternative with the supply constraint.

The derivation of the recreational value attributed to the opportunity cost of time unconstrained by supply for 1990 is presented in Table 15. The opportunity cost of time is the value of work or leisure activities foregone to travel to and recreate at the site. The calculation for the opportunity cost of time is similar to that for motor vehicle costs with the exception of the inclusion of on-site time. A relationship between travel time and length of stay in State parks has been established based on the 1978 Parks Visitor Survey conducted by New York State Office of Parks, Recreation, and Historic Preservation (NYSOPR). The survey was aimed at day use patrons at State parks. A regression analysis performed by NYSOPR relating length of stay with minutes of travel quantified the positive relationship between these two variables. It produced the equation, length of stay = .61 (travel time) + 263. Both variables are expressed in minutes. This relationship was utilized in travel cost method calculations for opportunity cost of time valuation for swimming. Table 15 shows the calculated second stage demand curve for hypothetical shifts in opportunity time costs for 1990 with no supply constraint. The recreational value for opportunity time costs for each alternative is calculated in the same method as motor vehicle costs. Average opportunity cost value per person is calculated as the total net willingness to pay ($3,107,200) divided by the projected swimming demand (1,619,304). Table 16 presents the recreational value for opportunity time cost in 1990 for each alternative with a supply constraint. Since there are no proposed entrance or user fees for day use participants at Maumee Bay State Park, no additional value is attributed to beach use.

Recreational value summaries by decade are presented in Table 17. Average annual equivalent values are calculated assuming straight line growth between decades using the Federal discount rate of 7-7/8 percent.

Table 13 - Maumee Bay State Park - Swimming
Second Stage Demand Curve, 1990
Motor Vehicle Cost

Distance Shift	Swimming Trips	Cost per Mile	Total Cost per Shift	Travel Cost
		$	$	$
0	483,229	.133	0.00	
				1,464,719.00
25	42,712	.133	6.65	
				278,791.30
50	14,763	.133	13.30	
				50,872.50
75	11,703	.133	19.95	
				101,804.90
100	7,329	.133	26.60	
				147,260.90
125	2,408	.133	33.25	
				46,962.30
150	1,124	.133	39.90	
				39,810.20
175	203	.133	46.55	
				10,124.60
200	0	.133	53.20	
Total Consumer Surplus				2,140,345.70

Table 14 - Maumee Bay Recreational Value, Motor Vehicle Cost, 1990

Alternative Width	Alternative Length	Beach Area	Annual Swimming Trips	Total Annual Value (1)
				$
100	2,500	250,000	121,945	540,126
100	3,000	300,333	143,240	634,447
150	2,500	375,000	174,798	774,225
100	4,000	400,000	185,133	820,002
150	3,000	450,000	205,773	911,427
200	2,500	500,000	226,066	1,001,305
100	5,500	550,000	245,797	1,088,698
200	3,000	600,000	264,667	1,172,278
150	4,000	600,000	264,667	1,172,278
250	2,500	625,000	273,955	1,213,417
250	3,000	750,000	317,338	1,405,579
200	4,000	800,000	334,045	1,479,571
150	5,500	825,000	341,830	1,514,053
250	4,000	1,000,000	386,976	1,714,016.4
200	5,500	1,110,000	409,786	1,815,048
250	5,500	1,375,000	452,131	2,002,605
300	5,500	1,650,000	475,493	2,106,081
350	5,500	1,925,000	481,025	2,130,584

(1) 4.43 Ave. Value/Trip.

Table 15 - Maumee Bay State Park - Swimming Second Stage Demand Curve, 1990 Opportunity Cost of Time

Distance Shift	Swimming Demand	Average Speed MPH	Average Distance of Drive (Two-Way)	Average Hours of Drive (Two-Way)	Average Hours Stay	Total Hours	Opportunity Rate/Hours	Total Cost Per Shift	Travel Cost
							$	$	$
0	1,691,304	44.0	0.0	0.00	4.38	4.38	1.86	8.15	
									14,696,761
25	149,494	44.0	50.0	1.14	4.73	5.87	1.86	10.91	
									1,202.288
50	51,671	44.0	100.0	2.27	5.08	7.35	1.86	13.67	
									161,172
75	40,961	44.0	150.0	3.41	5.42	8.83	1.86	16.43	
									272,590
100	25,653	44.0	200.0	4.55	5.77	10.32	1.86	19.19	
									354,217
125	8,429	44.0	250.0	5.68	6.12	11.80	1.86	21.94	
									104,816
150	3,935	44.0	300.0	6.82	6.46	13.28	1.86	24.70	
									84,088
175	711	44.0	350.0	7.95	6.81	14.76	1.86	27.46	
									20,505
200	0	44.0	400.0	9.09	7.16	16.25	1.86	30.22	
Gross Willingness to Pay									16,896,438
Net Willingness to Pay (Consumer Surplus)									3,107,236

Table 16 - Maumee Bay Recreational Value Opportunity Cost 1990

Alternative Width	Alternative Length	Beach Area	Annual Attendance	Total Annual Value (1)
100	2,500	250,000	426,807	784,123
100	3,000	300,000	501,243	921,054
150	2,500	375,000	611,793	1,123,976
100	4,000	400,000	648,062	1,190,431
150	3,000	450,000	720,062	1,323,149
200	2,500	500,000	791,187	1,453,637
100	5,500	550,000	860,337	1,580,509
200	3,000	600,000	926,469	1,701,846
150	4,000	600,000	926,469	1,701,846
250	2,500	625,000	958,719	1,761,569
250	3,000	750,000	1,110,775	2,040,529
200	4,000	800,000	1,169,057	2,147,956
150	5,500	825,000	1,196,353	2,198,016
250	4,000	1,000,000	1,354,386	2,488,311
200	5,500	1,110,000	1,434,293	2,634,983
250	5,500	1,375,000	1,582,458	2,907,266
300	5,500	1,650,000	1,664,246	3,057,487
350	5,500	1,925,000	1,683,589	3,093,059

(1) 1.84 average value/person.

Table 17 - Maumee Bay State Park - Swimming Recreational Value Summary (Option 2b and 3c)

Alternative		Beach	Total Recreational Swimming Value						Average Annual
Width	Length	Area	1990	2000	2010	2020	2030	2040	Equivalent Value (1)
100	2,500	250,000	1,324,200	1,327,600	1,331,600	1,337,000	1,343,900	1,348,500	1,329,200
100	3,000	300,000	1,555,500	1,558,900	1,564,500	1,572,400	1,581,900	1,591,200	1,561,500
150	2,500	375,000	1,898,200	1,901,700	1,907,200	1,914,600	1,924,300	1,936,700	1,904,200
100	4,000	400,000	2,010,400	2,014,400	2,020,400	2,028,300	2,038,100	2,050,300	2,017,100
150	3,000	450,000	2,234,600	2,238,200	2,244,900	2,254,200	2,265,400	2,278,500	2,241,500
200	2,500	500,000	2,454,900	2,460,500	2,466,600	2,475,800	2,488,300	2,503,100	2,463,100
100	5,500	550,000	2,669,200	2,676,600	2,685,800	2,697,000	2,709,000	2,724,600	2,679,900
200	3,000	600,000	2,874,100	2,885,100	2,899,800	2,913,300	2,929,500	2,944,900	2,889,800
150	4,000	600,000	2,874,100	2,885,100	2,899,800	2,913,300	2,929,500	2,944,900	2,889,800
250	2,500	625,000	2,974,900	2,988,000	3,003,900	3,021,400	3,038,200	3,056,100	2,993,100
250	3,000	750,000	3,446,100	3,466,600	3,494,400	3,527,200	3,557,700	3,589,200	3,476,600
200	4,000	800,000	3,627,500	3,651,700	3,680,700	3,715,900	3,756,200	3,792,600	3,662,000
150	5,500	825,000	3,712,100	3,741,900	3,772,900	3,808,600	3,850,800	3,891,900	3,751,500
250	4,000	1,000,000	4,202,300	4,273,900	4,350,100	4,421,500	4,491,300	4,549,700	4,293,300
200	5,500	1,110,000	4,450,000	4,529,700	4,629,300	4,740,700	4,840,900	4,936,900	4,562,200
250	5,500	1,375,000	4,909,900	5,035,100	5,181,500	5,330,900	5,490,400	5,661,200	5,079,700
300	5,500	1,650,000	5,163,500	5,346,000	5,550,800	5,764,600	5,997,100	6,235,300	5,407,500
350	5,500	1,925,000	5,223,600	5,439,300	5,711,200	6,012,000	6,324,600	6,633,000	5,530,800

Sensitivity. A number sensitivity tests were performed measuring the importance of critical input variables in the travel cost model. The first component analyzed was the distribution of day use visitor trips by origin zone based on the 1977 summer origin survey conducted by the Pennsylvania Department of Environmental Resources (Table 4). The first sensitivity run was based on a redistribution of visitor trips by origin zone limiting the maximum distance traveled to 100 miles. A second analysis is based on 1976 recreation origin survey conducted by Michigan Department of Natural Resources. The study provides the percentage distribution of people engaged in swimming by distance range. Table 18 displays the percent distributions by distance zone and the resultant per capita trip rate used for both sensitivity runs. Average annual equivalent recreational swimming benefits were calculated for alternative (250, 5,500) or 1,375,000-square foot beach. Under sensitivity test 1, beach benefits total $4,553,300. Under sensitivity test 2, beach benefits total $5,203,200. The second component analyzed for sensitivity to overall project benefits was space standard and turn over rate used to determine the daily beach capacity.

Seven alternatives (with the largest beach areas) were reanalyzed with a change in turnover rate from 1.5 to 2.0 and a change in space standard from 100 square feet per person to 75. The resultant average annual equivalent beach benefits were calculated and are shown in Table 19.

Table 19 - Sensitivity Analysis Beach Benefits using Turnover Rate of 2.0 and Space Standard of 75 Sq. Ft./Person

Alternative			
Width	Length	Beach Area	Average Annual Equivalent Benefits
200	4,000	800,000	5,149,900
150	5,500	825,000	5,211,100
250	4,000	1,000,000	5,484,000
200	5,500	1,110,000	5,540,100
250	5,500	1,375,000	5,576,900
300	5,500	1,650,000	5,584,100
350	5,500	1,925,000	5,584,600

Economic Efficiency of Protective Beach Alternative and the NED Plan - Table 20, below, summarizes the annual charges, benefits, net benefits, and benefit-to-cost ratios for the matrix of recreational beach alternatives. From the tabulation, it is seen that the larger beaches; both"with" and "without" breakwaters are the most economically efficient. Alternative 3c (300-5,500) - the 300-foot wide by 5,500-foot long beach with breakwaters - with net benefits of $3.7 million maximizes net benefits and is the NED plan. The benefit-to-cost ratio for Alternative 3c (300-5,500) is 3.2.

Table 18 - Sensitivity Analysis - Alter Trips Per Capita Function By Distance Zone

Zone	Distance In Miles	Percent Distribution of Day Use Visitors by Zone (1)	Trips Per Capita	Sensitivity 1 Redistribution of Visitors by Zone (2)	Trips Per Capita	Sensitivity 2 Distribution of Michigan Swimmers by Zone (3)	Trips Per Capita
1	0-25	.514	.65005	.5834	.73781	.81305	1.02825
2	26-50	.277	.03487	.3144	.03957	.05770	.00726
3	51-75	.049	.00200	.0556	.0227	.02696	.00110
4	76-100	.041	.00096	.0466	.00109	.01816	.00043
5	101-125	.04	.00092	0	0	.02615	.00060
6	126-150	.04	.00101	0	0	.02139	.00054
7	151-175	.024	.00144	0	0	.02116	.00127
8	176-200	.015	.00030	0	0	.02443	.00049

(1) SOURCE: 1977 Summer Recreation Origin Survey, Pennsylvania Department of Environmental Resources.

(2) SOURCE: Same as (1) except Redistribution with 100 miles maximum distance.

(3) SOURCE: 76 Survey, OMNR, Percentage Participation Swimming by Distance Range.

Table 20 - Comparison of Net Benefits and B/C for Option 2b (Without Breakwaters) and Option 3c (With Breakwaters) Alternatives (1)

Option (2)	Alternative		Total Annual Charges Federal Project and ODNR Development (3)	Total Annual Recreational Beach Benefits	Net Recreational Beach Benefits	Benefit-to-Cost Ratio
	Beach Width	Beach Length				
			$	$	$	
2b	350	5,500	1,953,500	5,300,800	3,347,300	2.7
2b	300	5,500	1,745,700	5,407,500	3,661,800	3.1
2b	250	5,500	1,537,700	5,079,700	3,542,000	3.3
2b	250	4,000	1,350,900	4,293,300	2,942,400	3.2
2b	250	3,000	1,284,500	3,476,600	2,192,100	2.7
2b	250	2,500	1,163,000	2,993,100	1,830,100	2.6
2b	200	5,500	1,500,700	4,562,200	3,061,500	3.0
2b	200	4,000	1,305,000	3,662,000	2,357,000	2.8
2b	200	3,000	1,208,400	2,889,800	1,681,400	2.4
2b	200	2,500	1,144,900	2,463,100	1,318,200	2.2
2b	150	5,500	1,782,800	3,751,500	1,968,700	2.1
2b	150	4,000	1,557,800	2,889,800	1,332,000	1.9
2b	150	3,000	1,364,700	2,241,500	876,800	1.6
2b	150	2,500	1,284,300	1,904,200	619,900	1.5
2b	100	5,500	1,933,000	2,679,900	746,900	1.4
2b	100	4,000	1,665,000	2,017,100	352,100	1.2
2b	100	3,000	1,499,900	1,561,500	61,600	1.04
2b	100	2,500	1,342,500	1,329,200	-13,300	0.99
3c	350	5,500	1,891,300	5,530,800	3,639,500	2.9
3c	300	5,500	1,706,900	5,407,500	3,700,600	3.2 (NED Plan)
3c	250	5,500	1,522,100	5,079,700	3,557,600	3.3
3c	250	4,000	1,339,500	4,293,300	2,953,800	3.2
3c	250	3,000	1,214,300	3,476,600	2,262,300	2.9
3c	250	2,500	1,161,900	2,993,100	1,831,200	2.5
3c	200	5,500	1,465,800	4,562,200	3,096,400	3.1
3c	200	4,000	1,310,800	3,662,000	2,351,200	2.8
3c	200	3,000	1,191,900	2,889,800	1,697,900	2.4
3c	200	2,500	1,138,900	2,463,100	1,324,200	2.2
3c	150	5,500	1,398,900	3,751,500	2,352,600	2.7
3c	150	4,000	1,280,100	2,889,800	1,609,700	2.3
3c	150	3,000	1,167,900	2,241,500	1,073,600	1.9
3c	150	2,500	1,093,000	1,904,200	811,200	1.7
3c	100	5,500	1,527,900	2,679,900	1,152,000	1.8
3c	100	4,000	[illegible],366,300	2,017,100	650,800	1.5
3c	100	3,000	1,230,900	1,561,500	330,600	1.3
3c	100	2,500	1,185,000	1,329,200	144,200	1.1

(1) February 1983 price levels, 7-7/8 percent interest rate, and 50-year project life.
(2) Option 2 Alternative - without breakwaters; Option 3 Alternative - with breakwaters.
(3) From Table 3.

INCREMENTAL ANALYSIS OF THE WILDLIFE REVETMENT

Introduction.

The 6,200-foot long wildlife revetment recommended in the Final Feasibility Report is shown in Enclosure 1. The purpose of the revetment would be to prevent further erosion of the shoreline along the easterly half of the park, thereby preserving the contiguous valuable wetland habitat while, in the view of the Ohio Department of Natural Resources (ODNR), permitting them to proceed with multi-use recreational development of the park. The State's position has been (and continues to be as expressed in the 2 November 1983 letter - Enclosure 2) that all features (facilities) of the park are integrally dependent and require shoreline protection over the entire 11,000 feet of shoreline to realize ultimate utilization of the complex. In this way, the State will achieve the optimum balance between development and preservation while realizing a balance between active and passive forms of recreation. The District agrees with the State's "integrally dependent" park development concept, and formulated the feasibility study plans using this concept including the need for total shoreline protection. On this basis, the wetland revetment was incorporated into the Recommended Plan based on economic justification of the total shoreline protection project.

With the recent determination that an incremental economic analysis of the wildlife revetment is required, recoordination of the project was initiated with the Ohio Department of Natural Resources in an attempt to quantify the tangible benefits associated with the revetment. As a result, by letter dated 14 November 1983 (Enclosure 3), ODNR informed the District Commander that the final location for the lodge and cabin complex had been determined. The decision is that the lodge/cabin cmplex will be located at the shoreline immediately to the east of North Curtice Road which is at the west end of the wildlife revetment (see Enclosure 1). ODNR further stated that the State would not construct the lodge/cabin complex at Maumee Bay State Park unless shoreline protection is provided for this site.

Considering these past and recent developments, an incremental economic analysis for the revetment was performed.

Cost of the Wildlife Revetment.

Based on the design and cost estimates prepared for the September 1982 FFR, the first cost for the 6,200-foot rubblemound revetment is $4,270,000 (February 1983 price levels). Total annual charges, based on a 50-year project life and 7-7/8 percent interest rate, are $456,000.

Benefits Associated With the Revetment.

The benefit categories for the easterly park revetment are:

a. Land-loss prevented benefits.

b. Elimination of on-shore cut-off walls.

c. Lodge benefits.

d. Cabin benefits.

These categories and their associated benefits are discussed below.

a. Land-Loss Prevented Benefits - Since a portion of the lands to be protected from shoreline erosion are wetlands, it was concluded that the monetary value of these lands is greater than the market value of about $4,000 per acre. To establish the monetary value of the estimated 150 acres adversely impacted without the project, the cost to create a similar environment through structural measures was used as a proxy. This approach seems reasonable since the Corps and others often use this practice to mitigate loss of wetlands in water resources development projects.

The principle construction features of the proxy wetland project are a low height earthen berm and a control structure. The first cost including lands for this proxy project is estimated at $1.3 million. The total annual charges, including O&M, for this proxy project are $122,000. Therefore, on the basis that this proxy project is a reasonable estimate of the value of the wetlands, the annual "land loss prevented" benefits allocable to the revetment are $122,000.

b. Cut-Off Wall Benefits - Without the revetment, a 600-foot on-shore cut-off wall would be required at the eastern end of the sand beach to prevent flanking of the beach as the unprotected portion of the shoreline recedes. Similarly, the existing U.S. Fish and Wildlife Service "Cedar Point Wildlife Refuge" revetment will require like construction as the now unprotected shoreline immediately to the west recedess. The wetland revetment under consideration for Maumee Bay State Park would eliminate the need for both of these cut-off walls. On this basis, it is concluded that eliminating the cost of these two cut-off walls with construction of the revetment is a benefit allocable to the revetment. The first cost of the walls is $500,000 and the annual charges, including O&M are $60,000. Thus, the annual benefits allocable to the revetment are $60,000.

c. Lodge Benefits - As previously stated, the Ohio Department of Natural Resources by letter dated 14 November 1983 (Enclosure 3), stated that the lodge and cabins will not and cannot be developed without total shoreline protection. Since development of the lodge/cabins complex is dependent upon shoreline protection, the District concluded that appropriate categories of benefits associated with the lodge and cabins are allocable to any type of shoreline protection provided at this site. The rubblemound revetment was selected because it is the least costly structural alternative.

Recreational benefits associated with the construction of a 150-room lodge have been calculated based on travel cost method procedures. The average annual equivalent benefits for the lodge total $210,200. This is based on opportunity time cost in travel and the variable vehicle cost. User fee revenues generated from the lodge are excluded from total recreational benefits, but are applied in demonstrating the cost of the lodge as being self liquidating. An engineering consultant analyzed the financial feasibility of

ODNR's proposed lodge development based on 75 percent annual occupancy rate. A summary of revenues and expenses is shown below:

Annual Operating Revenues	
Room Sales	$1,495,756
Food and Beverages	1,362,593
Other Sales	238,454
Total	$3,096,803

Variable Operating Expenses	
Rooms	$ 557,425
Food and Beverage	975,493
Other	77,420
Total	$1,610,338

Net Operating Revenues $1,486.465

Fixed Operating Expenses	
General Administrative	$232,260
Advertising and Promotion	123,872
Repair and Maintenance	226,067
Operator's Profit	154,840
Renovation and Replacement Reserve	154,840
Insurance	37,162
Total	$929,041

Net Revenues to State $557,424

The construction cost of $14.5 million (Feb 83) for the lodge would generate $557,400 annually to the State. The undiscounted payback period equates to approximately 26 years and the rate of return on investment is about 4 percent. The associated costs of lodge construction, therefore, is considered self liquidating and are not included in benefit cost calculations.

d. Cabin Benefits - ODNR also has plans to construct 50 cabins at a cost of around $1.1 million. Recreational benefits are calculated using the travel cost approach. Average annual equivalent benefits with the cabins total $32,400. Like the lodge analysis, user fee revenues for the cabins are excluded from recreational benefits and the associated costs for cabins development are treated as self liquidating.

e. Summary of Benefits Allocable to the Rubblemound Revetment - The average annual benefits for the 6,200-foot revetment are:

Land Loss Prevented Benefits	$122,000
Cut-Off Walls Eliminated	60,000
Lodge Benefits	210,200
Cabin Benefits	32,400
Total Annual Benefits	$426,600

Economic Efficiency of the Rubblemound Revetment Feature.

With total annual benefits of $426,600 and total annual charges of $456,000, the net benefits for this incremental feature of the Federal shoreline project are -$29,400 and the benefit-to-cost ratio is 0.93.

DESIGNATION OF THE NED PLAN

The District is of the position that the proposed multi-use recreational complex presently being developed by the Ohio Department of Natural Resources is an integrally-dependent facility requiring erosion protection along the entire 11,000 feet of park shoreline to implement the envisioned development plan. Therefore, candidate NED plans must incorporate the most economically efficient shoreline protection features meeting this criterion. For the Federal shoreline protection/beach restoration project, these principal features are a protective sand beach along the western 5,500 feet of park shoreline and a 6,200-foot long rubblemound revetment along the eastern 5,500 feet of park shoreline. In addition, there are two variations of the sand beach feature providing different recreational fishing benefits that must be considered in identifying the NED plan. From the optimization studies presented earlier, it was shown that the maximum net benefits ($3,700,600) for the protective beach "with" breakwaters (Option 3c) were obtained for the 300-foot wide by 5,500-foot long beach. Similarly, the 300-foot by 5,500-foot beach (Alternative 2b (300'W-5,500'L)) maximized net benefits ($3,661,800) for the "without" breakwaters option. A comparison of annual charges vs. annual benefits for the two candidate plans follows:

Item	Alternative 2b (300'W-5,500'L) (Sand Beach, Revetment)	Alternative 3c (300'W-5,500'L) (Sand Beach with Breakwaters, Revetment)
Annual Charges(1)		
Beach	$1,745,700 (4)	$1,706,900 (4)
Revetment	456,000	456,000
Jetty Fishing	6,400 (2)	4,500 (3)
Total Charges	$2,208,100	$2,167,400
Annual Benefits(1)		
Beach	$5,407,500	$5,407,500
Revetment	426,600	426,600
Jetty Fishing	30,300	24,400
Total Benefits	$5,864,400	$5,858,500
Net Benefits	$3,656,300	$3,691,100
B/C Ratio	2.66	2.70

(1) February 1983 price levels, 50-year project life and 7-7/8 percent interest rate.
(2) For 700 feet of concrete walkway on the beach jetties.

AD-A138 420 MAUMEE BAY STATE PARK OHIO SHORELINE EROSION BEACH RESTORATION STUDY FINA..(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT DEC 83 6/6

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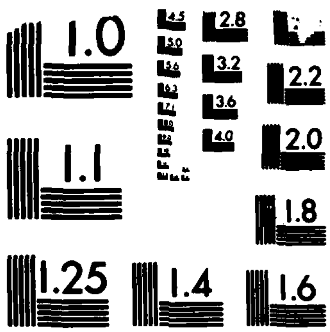


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(3) For 500 feet of concrete walkway on the beach jetties.
(4) Includes $678,900 annual charges for ODNR's beach-related development.

From the tabulation above, Alternative 3c (300'W-5,500'L), with net annual benefits of $3,691,100, is designated the NED Plan.

DESIGNATION OF THE EQ PLAN

In the September 1982 FFR, the alternative plan without breakwaters (Alternative 2b for this Supplemental Report) was selected as the EQ Plan, primarily because it would be the least disruptive to existing current and drift patterns which influence fish and aquatic movement, recruitment, and utilization of near shore areas. Alternative 2b would also be the least damaging to the existing aesthetic conditions of the shoreline, while still providing a recreational beach and shoreline protection at Maumee Bay State Park. Therefore, Alternative 2b - protective beach without breakwaters, and rubblemound revetment - is selected as the EQ Plan.

DESIGNATION OF THE SELECTED PLAN

Current policy requires that the NED Plan must be designated as the Selected Plan unless there are strong overriding factors dictating an alternative determination. Based on the NED criterion, Alternative 3c (300'W-5,500'L), with net benefits of $3,700,600 (Feb 83 prices), would be the Selected Plan.

However, there are several other important considerations that the District feels are germane to the decision in plan selection for the Maumee Bay State Park project. First, it believes that although the primary objective is to realize the greatest National economic return for the dollars invested, another objective is to develop water resources projects that meet the planning objectives at the minimum possible cost. For the Federal project at Maumee Bay State Park, there are alternatives to the NED Plan that meet the lower cost criterion and the planning objectives. These alternatives would have a narrower beach, and, therefore, lower costs. Another important consideration in plan selection is the desires of the local sponsor. For the Maumee Bay State Park project, the Ohio Department of Natural Resources strongly prefers less beach capacity than would be provided by the 300-foot wide by 5,500-foot long NED Plan because it is not consistent with the ancillary beach facilities (bathhouse, parking, picnic facilities) planned for the park. In addition, a 200-foot to 250-foot wide beach is considered an optimal width for shoreline protection purposes. It would obviously be imprudent to consider an alternative to the NED Plan that significantly reduces net benefits below those that would be produced by the NED Plans. Therefore, if an alternative to the NED were to be selected, the District feels the net benefits for the alternative plan should reasonably approximate the net benefits for the NED Plan, thus limiting the reduction in beach size. Lastly, if at some future date, the State decides that additional beach capacity is necessary, this capacity could readily be provided in the form of a grass beach area immediately landward from the proposed storm dune.

Having considered all these factors, Alternative 3c (250'W-5,500'L) has been designated as the Selected Plan. It is the same as the NED Plan in every respect except that the 5,500-foot long beach would be 250 feet wide instead of 300 feet wide. This will reduce the instantaneous beach capacity by 2,500 people. Conversely, it will provide an instantaneous capacity of 13,750 people. With total annual charges of $1,980,600 and total annual benefits of $5,530,100, the net benefits for Alternative 3c (250'W-5,500'L) are $3,549,500, and the benefit-to-cost ratio is 2.79. When compared to the NED Plan, net benefits for the Selected Plan 3c (250'W-5,500'L) are $141,000 lower and the B/C ratio is 0.09 higher. The first cost for Alternative 3c (250'W-5,500'L) is $11,551,000, or $517,000 less than for the NED Plan.

In summary, Plan 3c (250'W-5,500'L) is designated as the Selected Plan for the following reasons:

a. First cost is $517,000 less, and annual charges are $186,800 less than for the NED Plan;

b. Although net benefits for the Selected Plan are $141,000 less than for the NED Plan, this only represents a reduction of 2 percent in the NED Plan net benefits. In addition, the B/C is greater than for the NED Plan.

c. The Ohio Department of Natural Resources prefers the smaller beach, and the provided capacity is consistent with the ancillary facilities planned for the parks; and

d. The beach area can readily be expanded by constructing a grass beach, if necessary.

Updated Cost Estimate (October 1983 Price Levels) for the Selection Plan.

The detailed cost estimate, at October 1983 price levels, for Alternative 3c (250'W-5,500'L), is as follows:

Item Federal Project	Quantity	Unit	Unit Price	Estimated Amount
			$	$
Clearing and Grubbing	8	Acre	3,650.00	29,200
Ditch Excavation	1,670	C.Y.	5.85	9,770
Stripping	22,800	C.Y.	7.95	181,260
Sandfill	300,000	Ton	5.95	1,785,000
Earthfill	45,200	C.Y.	2.60	117,520
Armor Stone (1-3 Ton)	31,100	Ton	37.25	1,158,475
Armor Stone (1,200-2,800 pounds)	5,400	Ton	43.65	235,710

Updated Cost Estimate (October 1983 Price Levels) for the Selection Plan. (Cont'd)

Item Federal Project	Quantity	Unit	Unit Price	Estimated Amount
			$	$
Armor Stone (700-1,500 pounds)	46,750	Ton	43.65	2,040,638
Underlayer Stone (80-280 pounds)	1,900	Ton	31.40	59,660
Underlayer Stone (50-150 pounds)	23,700	Ton	31.40	744,180
Underlayer Stone (3-30 pounds)	25,900	Ton	25.00	647,500
Aids to Navigation	-	L.S.	-	87,200
Concrete Walkway	500	L.F.	61.00	30,500
Filter Fabric	36,000	S.Y.	7.15	257,400
Topsoil	4,500	C.Y.	11.25	50,625
Seeding	8	Acre	1,750.00	14,000
Mobilization and Demobilization	-	L.S.	-	150,000
TOTAL CONTRACTOR'S EARNINGS				7,598,638
CONTINGENCIES AT 25 PERCENT±				1,901,362
TOTAL CONTRACTOR'S EARNINGS PLUS CONTINGENCIES				9,500,000
ENGINEERING AND DESIGN				900,000
SUPERVISION AND ADMINISTRATION				1,190,000
LANDS	60	A.L.	4,000.00	240,000
TOTAL FIRST COST OF CONSTRUCTION				$11,830,000
ODNR DEVELOPMENT				
Access Roads				810,000
Parking Lot				1,260,000
Two Bathhouses				750,000
Two Change Booths				100,000
Utilities				250,000
Lands				160,000
Total Cost, ODNR Development				$ 3,330,000

Updated Average Annual Costs, Annual Benefits, and Net Benefits for the Selected Plan.

Average Annual Costs for the Selected Plan 3c (250'W-5,500'L) - The average annual costs on October 1983 price levels and at 8-1/8 percent interest rate, for Alternative 3c (250'W-5,500'L) are shown in the tabulation below. From the tabulation, the average annual charges for the Federal project are $1,291,000. In addition, the annual charges for the associated ODNR development (bathhouse, beach parking, picnic areas) are $714,000, resulting in total annual charges of $2,005,000 allocable to the Federal Project.

Annual Charges for Alternative 3c (250'W-5,500'L) - Protective Sand Beach, Offshore Breakwaters, Revetment, and Concrete Fishing Walkway) (October 1983 price levels)

Item	Annual Costs (1)
FEDERAL PROJECT (2)	
First Cost Altternative 3c (250'W-5,500'L)	$11,830,000
Interest during Construction (.08187)	970,000
Total Investment Cost	$12,800,000
Annual Charges	
Interest and Amortization (0.08292)	1,061,000
Beach Nourishment (3) (5,000 cy)	45,000
Beach Monitoring	14,000
Maintenance of Structures (4)	156,000
Total Annual Charges, Federal Project	$1,276,000
ODNR DEVELOPMENT (5)	
First Cost	3,170,000
Lands (40 AL)	160,000
Total First Cost, ODNR Development	$3,330,000
Annual Charges	
Interest and Amortization	276,000
Operations and Maintenance	125,000
Total Annual Charges, ODNR Development	$401,000
Grand Total Annual Charges Federal Project and Associated ODNR Development	$1,667,000

(1) Based on 50-year project life and 8-1/8 percent interest rate.
(2) Based on traditional cost sharing, 70 percent Federal and 30 percent non-Federal except lands which are 100 percent non-Federal and Aids to Navigation which are 100 percent Federal.
(3) Beach nourishment to be performed for the life of the project, apportioned 70 percent Federal and 30 percent non-Federal.
(4) 100 percent non-Federal
(5) 100 percent non-Federal costs.

<u>Average Annual Benefits for the Selected Plan 3c (250'W-5,500'L)</u> - From the tabulation below the total average annual benefits, based on October 1983 prices, a 50-year project life and 8-1/8 percent interest rate, are $5,711,000.

Benefit Category	Annual Benefits
Recreational Beach Benefits	$5,300,000
Land Loss Prevented (Beach Area)	7,000
Jetty Fishing Benefits	32,000
Revetment	
Land-Loss Prevented	54,000
Cut-Off Walls Eliminated	61,000
Lodge Benefits	219,000
Cabin Benefits	34,000
Total Project Benefits	$5,707,000

<u>Economic Efficiency of Selected Plan 3c (250'W-5,500'L)</u>.

From the summary below, the net benefits (on October 1983 price levels, 50-year project life, and 8-1/8 percent interest rate) for Alternative 3c (250'W-5,500'L) are $3,768,000 and the benefit-to-cost ratio is 2.88.

Annual Charges	$1,677,000
Annual Benefits	$5,707,000
Net Benefits	$4,030,000
Benefit-to-Cost Ratio	3.41

RECOMMENDATION

After consideration of environmental, social, economic, and institutional effects, as well as engineering feasibility, I have concluded that the optimum plan for accomplishing the planning objectives is Alternative 3c (250'W-5,500'L). I, therefore, recommend that the Selected Plan which would provide a protective sand beach 250 feet long and 5,500 feet wide with offshore breakwaters and a rubblemound revetment, with such modifications as in the discretion of the Chief of Engineers may be advisable, all for preventing shoreline erosion while providing for beach restoration over the westerly half of the shoreline, be authorized for implementation as a Federal project, subject to cost-sharing and financing arrangements with the responsible non-Federal agency sponsoring the project, which are satisfactory to the President and the Congress. This recommendation is made cognizant that the rubblemound revetment, with a benefit-to-cost ratio of 0.92 is not incrementally justified. However, I believe that the "integrally dependent" park development concept, whereby the contemplated multi-use recreational park complex requires total shoreline protection, must be considered as an overriding factor to incremental justification to the revetment, particularly in consideration of the strong economic efficiency of the total project plan. The first cost of the Federal project is presently estimated at $11,830,000, with a first cost to the United States of $8,136,000. The annual operations and maintenance costs are estimated at $281,000, in addition $45,000 apportioned to the United States for periodic nourishment.

The project sponsor, the Ohio Department of Natural Resources, has indicated their intent to provide the following Items of Local Cooperation, except for Item c, having recently been changed and, therefore, requiring recoordination:

a. Provide without cost to the United States, all lands, easements, and rights-of-way, including borrow and spoil disposal areas as determined by the Chief of Engineers, necessary for the construction and subsequent maintenance of the project.

b. Contribute in cash 30 percent of the project construction cost, excepting the cost of periodic beach nourishment, to be paid in a lump sum prior to initiation of construction. In the event such construction is scheduled over more than one Federal Fiscal Year, said contribution may be made in annual installments over the period of construction at a rate proportionate to the proposed or scheduled apportionment of Federal funds to the project with the final apportionment of cost to be made after actual completion of construction and determination of actual costs;

c. Provide appurtenant facilities shown on the State's Master Plan, for which recreational benefits have been taken;

d. Hold and save the United States free from all claims for damage due to construction, operation, and maintenance of project, except for damage due to the fault or negligence of the Government or its Contractors;

e. Provide without cost to the United States all alterations and relocations to existing improvements including highways, buildings, utilities, sewers, and other facilities which may be required in connection with the construction of the project;

f. Construct permanent park structures and park roads above the 100-year water surface elevation of 577.3 IGLD and consider such elevation when constructing other facilities, which would be significantly affected by high waters;

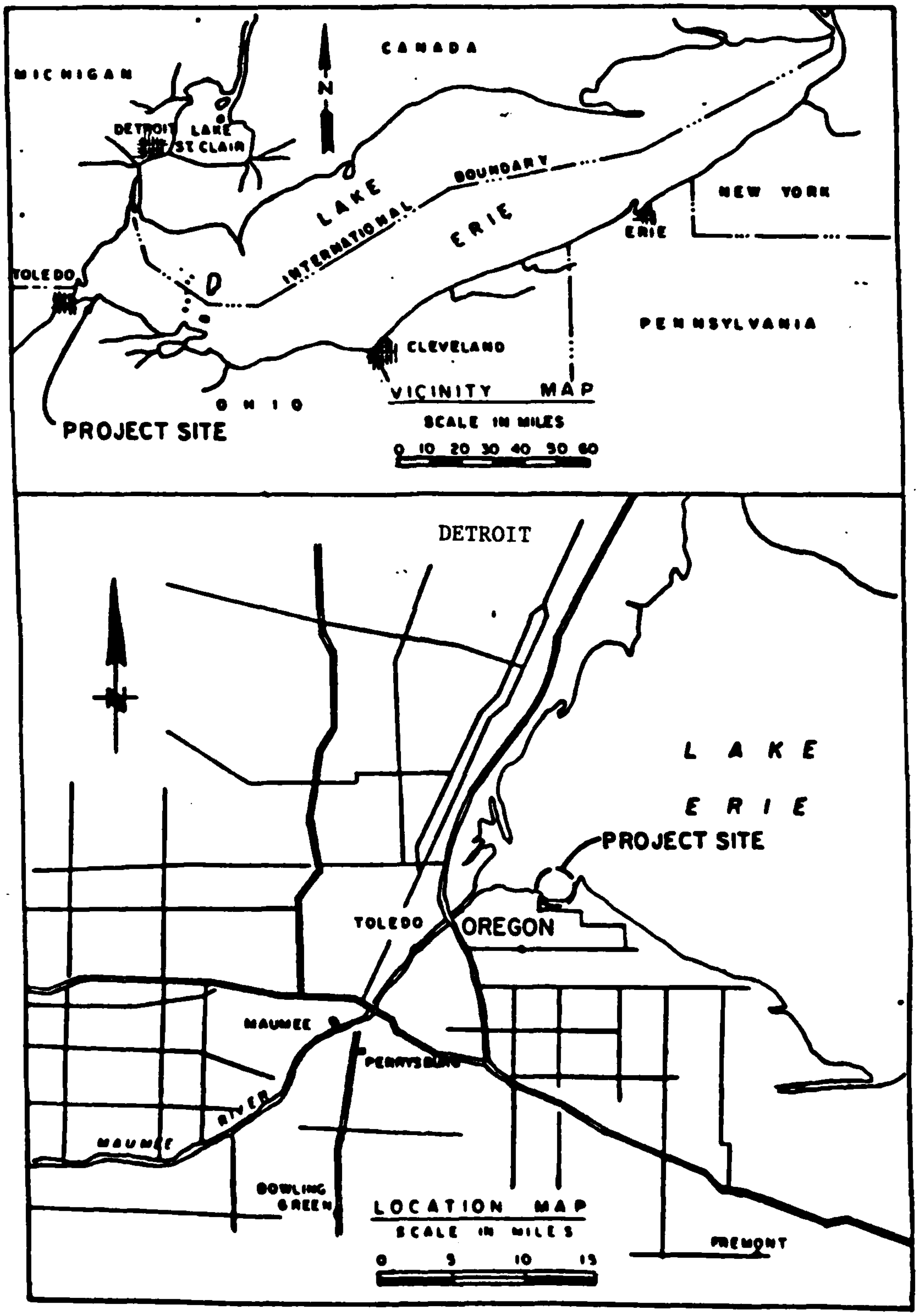
g. Maintain and repair the protective and improvement measures during the useful life thereof as may be required to serve their intended purposes. Carry out, in accordance with written directions from the District Commander or his successor, the periodic beach nourishment program with the only cost to the United States being the annual reimbursement to the State of 70 percent of the State's expenditure therefore, subject to the availability of Federal funds.

h. Control water pollution from within the park to the extent necessary to safeguard the health of the bathers;

i. Maintain continued public ownership and use of the shore upon which the Federal participation is based during the economic life of the project;

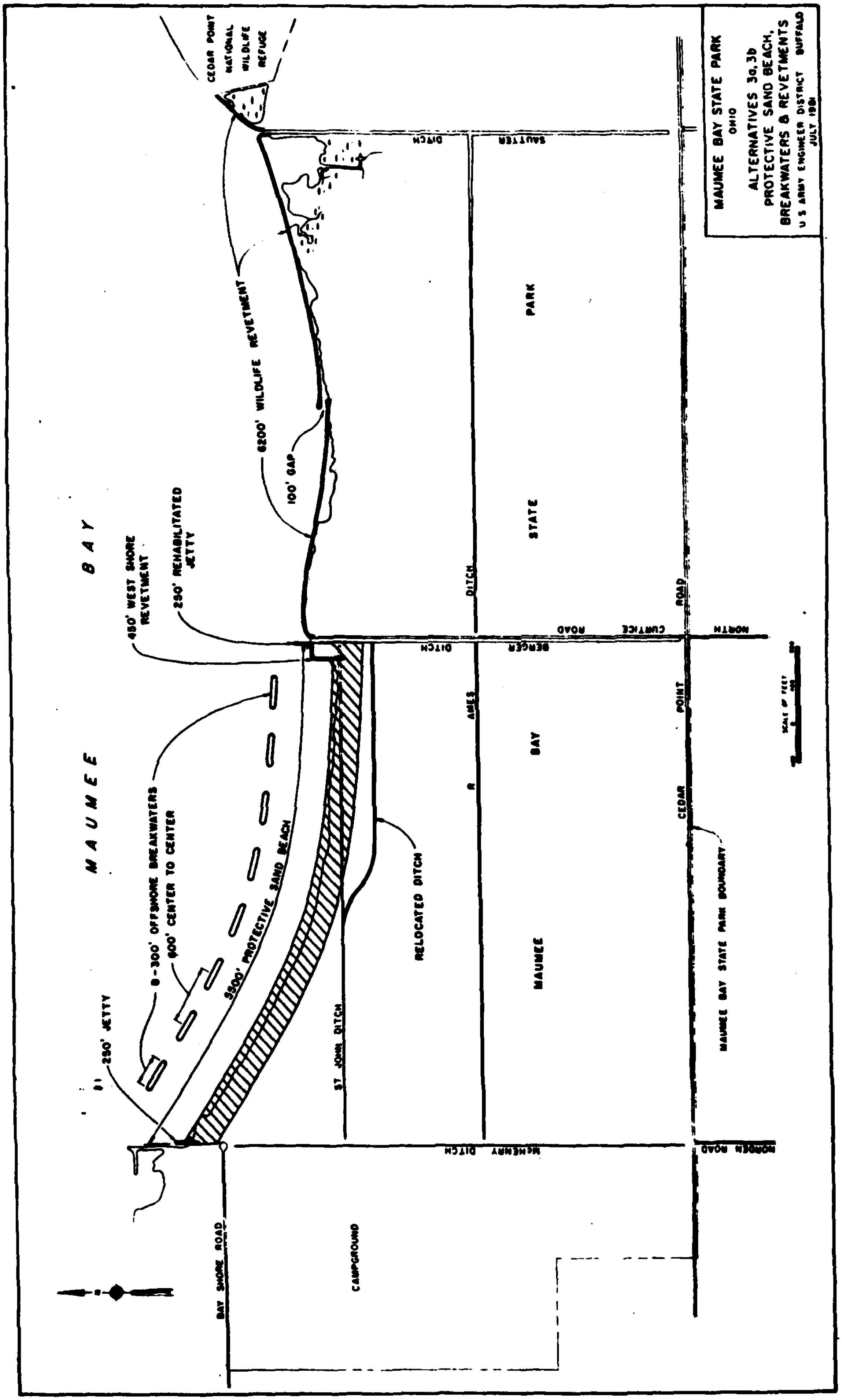
j. Provide and maintain necessary access roads, parking areas, and other public use facilities open and available to all on equal terms; and,

k. Comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisitions Policies Act of 1970, Public Law 91-646, approved 2 January 1971, in acquiring lands, easements, and rights-of-way for construction and subsequent maintenance of the project, and inform affected persons of pertinent benefits, policies, and procedures in connection with said Act.



VICINITY AND LOCATION MAPS

PLATE 1


MAUMEE BAY STATE PARK
OHIO
ALTERNATIVES 3a, 3b
PROTECTIVE SAND BEACH,
BREAKWATERS & REVETMENTS
U S ARMY ENGINEER DISTRICT BUFFALO
JULY 1981
CEDAR POINT NATIONAL WILDLIFE REFUGE
MAUMEE
BAY
6200' WILDLIFE REVETMENT
100' GAP
250' REHABILITATED JETTY
450' WEST SHORE REVETMENT
8-300' OFFSHORE BREAKWATERS
600' CENTER TO CENTER
3500' PROTECTIVE SAND BEACH
250' JETTY
RELOCATED DITCH
ST JOHN DITCH
SAUTTER DITCH
BERGER DITCH
NORTH CURTICE ROAD
AMES R DITCH
McHENRY DITCH
CEDAR POINT ROAD
NORDEN ROAD
BAY SHORE ROAD
CAMPGROUND
MAUMEE BAY STATE PARK
MAUMEE BAY STATE PARK BOUNDARY
SCALE OF FEET

ENCLOSURE 1

ODNR
OHIO DEPARTMENT OF
NATURAL RESOURCES

Fountain Square
Columbus, Ohio 43224

11-10-83

November 2, 1983

Robert R. Hardiman, Colonel
District Engineer
U.S. Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

RE: October 31, 1983 Field Review on Maumee Bay State Park
Proposed Shore Erosion Control Project

Dear Colonel Hardiman:

Based on the results of the referenced meeting, I am writing to summarize the position of the Ohio Department of Natural Resources concerning proposed erosion protection measures for the Lake Erie shoreline of Maumee Bay State Park.

Early in the planning process it was agreed that as a major premise, protection along the entire 10,000' of park shoreline must be an integral feature of the park if it is to be developed as a multi-recreational complex. Further, the economic evaluation on total cost for protecting the entire shoreline and total water-related and water-enhanced benefits derived would be based on the entire park complex. Such agreement is documented in the District Engineer's report on the Maumee Bay State Park project of September, 1982 (revised June, 1983).

As you are aware, the Congress is currently considering water resources legislation that includes a provision authorizing the Maumee Bay State Park shore protection project as proposed in the District Engineer's report. Any attempt to modify the agreed upon premise for economic evaluation of the proposed project could seriously jeopardize the selected alternative 3b, and negate expected Congressional action. Any amended project recommendation as may be considered by the staff of BERH that would not provide the degree of protection, nor include appropriate beach facilities afforded by alternative 3b, would not be acceptable to the Ohio Department of Natural Resources.

Maumee Bay State Park-Proposed Shore
Erosion Control Project

We would appreciate your cooperation in conveying our position on this project to appropriate officials in the Corps. Further, we sincerely appreciate the tremendous time and effort expended by your staff toward advancing the proposed project to the Board.

We look forward to a positive decision by the BERH in sustaining the recommendations of both the District and Division Engineers.

Sincerely,

Myrl H. Shoemaker

MYRL H. SHOEMAKER
Director

MHS:mh

ODNR
OHIO DEPARTMENT OF NATURAL RESOURCES

Fountain Square
Columbus, Ohio 43224

November 14, 1983

OFC. MGMT. OAS
15 NOV 83 11 09

Robert R. Hardiman, Colonel
District Engineer
U.S. Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Hardiman:

On November 14, 1983, members of our staff met with the A/E firm the Ohio Department of Natural Resources engaged to produce conceptual plans for the proposed lodge and cabins development at Maumee Bay State Park. Based on the results of this meeting, the lodge facility will be located near the center of the park lands, along the northerly terminus of North Curtis Road, and immediately adjacent to the Lake Erie shoreline. The cabins will be constructed immediately east of this location.

The final location of these proposed facilities underscores the overriding requirement that the entire park shoreline receive adequate protection from erosion.

In my previous correspondence to you of November 2, 1983, I expressed a preference for erosion protection alternative 3b, and further indicated that any alternative not affording the same degree of protection as alternative 3b would be unacceptable. I now want to emphatically express that the Ohio Department of Natural Resources will not and cannot develop the lodge, cabins, and ancillary facilities without total shoreline protection. Accordingly, our participation in any federally authorized project is contingent upon this factor.

Again, I wish to thank you and your staff for your continued cooperation. We are looking forward to an expedient review of the results on the Maumee Bay State Park Shoreline Erosion/Beach Restoration Study.

Sincerely,

Myrl H. Shoemaker

MYRL H. SHOEMAKER
Director

MHS:mh

ENCLOSURE 3

Table 20 - Comparison of Net Benefits and B/C for Option 2b (Without Breakwaters) and Option 3c (With Breakwaters) Alternatives (1)

Option (2)	Alternative: Beach Width	Alternative: Beach Length	Total Annual Charges Federal Project and ODNR Development (3)	Total Annual Recreational Beach Benefits	Net Recreational Beach Benefits	Benefit-to-Cost Ratio
			$	$	$	
2b	350	5,500	1,953,500	5,300,800	3,347,300	2.7
2b	300	5,500	1,745,700	5,407,500	3,661,800	3.1
2b	250	5,500	1,537,700	5,079,700	3,542,000	3.3
2b	250	4,000	1,350,900	4,293,300	2,942,400	3.2
2b	250	3,000	1,284,500	3,476,600	2,192,100	2.7
2b	250	2,500	1,163,000	2,993,100	1,830,100	2.6
2b	200	5,500	1,500,700	4,562,200	3,061,500	3.0
2b	200	4,000	1,305,000	3,662,000	2,357,000	2.8
2b	200	3,000	1,208,400	2,889,800	1,681,400	2.4
2b	200	2,500	1,144,900	2,463,100	1,318,200	2.2
2b	150	5,500	1,782,800	3,751,500	1,968,700	2.1
2b	150	4,000	1,557,800	2,889,800	1,332,000	1.9
2b	150	3,000	1,364,700	2,241,500	876,800	1.6
2b	150	2,500	1,284,300	1,904,200	619,900	1.5
2b	100	5,500	1,933,000	2,679,900	746,900	1.4
2b	100	4,000	1,665,000	2,017,100	352,100	1.2
2b	100	3,000	1,499,900	1,561,500	61,600	1.04
2b	100	2,500	1,342,500	1,329,200	-13,300	0.99
3c	350	5,500	1,891,300	5,530,800	3,639,500	2.9
3c	300	5,500	1,706,900	5,407,500	3,700,600	3.2 (NED Plan)
3c	250	5,500	1,522,100	5,079,700	3,557,600	3.3
3c	250	4,000	1,339,500	4,293,300	2,953,800	3.2
3c	250	3,000	1,214,300	3,476,600	2,262,300	2.9
3c	250	2,500	1,161,900	2,993,100	1,831,200	2.5
3c	200	5,500	1,465,800	4,562,200	3,096,400	3.1
3c	200	4,000	1,310,800	3,662,000	2,351,200	2.8
3c	200	3,000	1,191,900	2,889,800	1,697,900	2.4
3c	200	2,500	1,138,900	2,463,100	1,324,200	2.2
3c	150	5,500	1,398,900	3,751,500	2,352,600	2.7
3c	150	4,000	1,280,100	2,889,800	1,609,700	2.3
3c	150	3,000	1,167,900	2,241,500	1,073,600	1.9
3c	150	2,500	1,093,000	1,904,200	811,200	1.7
3c	100	5,500	1,527,900	2,679,900	1,152,000	1.8
3c	100	4,000	1,366,300	2,017,100	650,800	1.5
3c	100	3,000	1,230,900	1,561,500	330,600	1.3
3c	100	2,500	1,185,000	1,329,200	144,200	1.1

(1) February 1983 price levels, 7-7/8 percent interest rate, and 50-year project life.
(2) Option 2 Alternative - without breakwaters; Option 3 Alternative - with breakwaters.
(3) From Table 3.

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